Army Mountain Warfare School

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Basic Military Mountaineer Course
Student Handout

2013

	ARMY MOUNTAIN WARFARE SCHOOL
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Soldier's Creed

I am an American Soldier.

I am a Warrior and a member of a team. I serve the people of the United States and live the Army Values.

I will always place the mission first.

I will never accept defeat.

I will never quit.

I will never leave a fallen comrade.

I am disciplined, physically and mentally tough, trained and proficient in my warrior tasks and drills. I always maintain my arms, my equipment and myself.

I am an expert and I am a professional.

I stand ready to deploy, engage, and destroy the enemies of the United States of America in close combat.

I am a guardian of freedom and the American way of life.

I am an American Soldier.

This handout includes lessons for all basic Military Mountaineer Courses.

CHAPTER TABLE OF CONTENTS Page

Soldier's Creed……2
History of the Ram's Head Device…… 4
Welcome and Comments……5
Safety Statement……6
Environmental Statement……7
Operational Environment……8
1 Basic Mountaineering Equipment……9
2 Basic Knot Tying……20
3 Rope Management……42
4 Cold Weather Clothing……44
5 Environmental Injuries……53
6 Mountain Operations……61
7 Characteristics of Mountain Terrain……67
8 Soldier Load Management……70
9 Mountain Travel Techniques……72
10 Anchors……75
11 Mountain Weather……90
12 Basic Mountain Casualty Evacuation……95
13 Altimeter Land Navigation……104
14 Avalanche Awareness and Rescue……107
15 Hauling Techniques……117
16 Environmental Effects on Weapons……120
17 Animal Packing……128
18 Rappelling in Mountainous Terrain……133
19 Fixed Ropes……137
20 Water Procurement……145
21 Climbing Techniques……148
22 Additional Height Construction……167
23 High Lines……171
24 Communications in a Mountainous Environment……176
25 Vertical Danger Area……180
26 Mountain Patrol Base and Bivouac Operations……186
27 Aerial Resupply……207
28 High Altitude Illness and Prevention……209
29 Confined Space Exploration and Clearing……215
References and Equipment Recommendations……217
Appendix A – Long Distance Holds for ACOGs and CCOs……218

The History of the Ram's Head Device

85th Regimental Crest

Ram's Head Device

The Military Mountaineer Badge, commonly known as the Ram's Head Device, is derived from the 85th Infantry Regimental Crest which is topped by a ram's head symbolizing a unit skilled in mountain activity. The 85th was one of three regiments comprising the 10th Light Division (Alpine) when it was activated in July, 1943. The 85th Infantry Regiment trained in mountain and cold-weather warfare at Camp Hale, Colorado in 1943 and 1944. The 85th then conducted extensive mountain combat operations in Italy during World War II including actions at Riva Ridge, Mount Belvedere Ridge and the Po Valley. The 10th Light Division (Alpine) later became the 10th Mountain Division, headquartered at Fort Drum, New York.

In the 1950s, the United States Army Mountain and Cold Weather Training Command at Fort Carson and Camp Hale, Colorado adopted the Ram's Head Device as the badge worn by their cadre.

In 1983, the Vermont Army National Guard Mountain Warfare School was established in Jericho, Vermont to train the 3rd Battalion, 172nd Infantry (Mountain) as the first unit in an Army Regimental Mountain Concept Plan. The Ram's Head Device was adopted as the Military Mountaineer Badge denoting successful completion of the Basic Military Mountaineer Course and awarding of the Skill Qualification Identifier – Echo "Military Mountaineer." The 3rd Battalion later became the 86th Infantry Brigade Combat Team (Mountain), headquartered in Jericho, Vermont.

In 2003 the Vermont Army Mountain Warfare School became the United States Army Mountain Warfare School. As such it was designated the Executive Agent for military mountaineering with the United States Army Infantry School as its proponent and became responsible for teaching both active and reserve component Soldiers.

The Army Mountain Warfare School continues to award the Ram's Head Device to Soldiers who complete the Basic Military Mountaineer Course. The Ram's Head was chosen in recognition of the sacrifices our mountain Soldiers made during World War II and the proud tradition of the United States Army's past mountain warfare training institutions.

Commander's Welcome and Comments

1. Welcome to the Army Mountain Warfare School (AMWS). During this course you will receive some of the finest training the US Army has to offer. Our instructors are ready to pass on knowledge gained from years of experience and multiple combat deployments. The entire AMWS cadre is here to support you and we welcome any feedback you have regarding the course or the support we provide you. Mountain warfare training is inherently difficult and carries with it a certain amount of risk. For this reason safety is our top concern while you are here at the AMWS. I ask that you remain focused on the training and obey our policies, procedures and the guidance of our cadre at all times.

2. Mountainous terrain and the resulting harsh climate present unique challenges. This course provides you the skills needed to solve these problems and enable your unit to use the environment to its advantage.

3. Mountain warfare is unforgiving. To the ill-prepared, mountains are a terrible foe. Armed with the knowledge you gain here, along with discipline, mental agility and physical toughness, you will find the mountains a strong ally as you take the fight to the enemy.

"Training Mountain Warriors!"

//Original Signed//
JUSTIN H. DAVIS
LTC, IN
Commanding

Safety Statement

Safety considerations are everyone's concern. Instructors will point out specific safety requirements during each block of instruction. Always observe the following safety points:

1. Wear helmets and safety yourself in when working on or near vertical surfaces.
2. Make sure all locking carabiners are locked and all non-locking carabiners have their gates opposite and opposed.
3. Properly inspect and wear your climbing harness. ***(Be sure to double pass buckles if applicable).***
4. Inspect all equipment prior, during and after use.
5. Inspect all knots.
6. While rappelling, confirm that the rope hits the ground or tie a knot in the end of the ropes to prevent rappelling off.
7. Be alert to changing climbing conditions.
8. Be aware of falling ice or rocks at all times.
9. Triple check all anchors.
10. Climb within your ability.
11. Use proper communication methods.
12. Whenever possible, use static double ropes in installations.
13. Use the buddy system to monitor dehydration, heat injuries and environmental injuries.
14. Do not interfere with the wildlife.
15. When building and utilizing warming fires, never stand or dry objects too close to the source.
16. Treat all weapons as if they are loaded. ***(Never point your weapon at anything you are not willing to shoot).***
17. Maintain positive target ID.
18. Ensure you are aware what is behind and in front of your target.
19. Maintain terrain awareness.
20. Be aware of footing, utilizing taught walking techniques to minimize injuries.
21. Never run in training areas unless specifically directed by instructors.
22. When in doubt—ask questions!

Environmental Statement

1. Responsibility. It is the responsibility of all Soldiers to protect the environment from damage. Careful planning and preparing for your mission can minimize impact on the environment.

2. Plan and prepare. Careful planning can help ensure that impact concerns and safety expectations are met.

3. Durable surfaces. Bivouac and travel on durable surfaces. It is best to use surfaces that are durable or highly resistant to impact. These include rock, sand, gravel, snow, pine needles and leaf litter.

a. Stay on marked trails unless otherwise directed by an instructor.
b. Use bridges wherever and whenever possible.
c. Take rest breaks on durable surfaces.
d. Ground equipment and eat only in areas designated by the PI.
e. Avoid fragile areas.
f. Smoke only in areas designated by an instructor. Police all related refuse.

4. Avoidance. Avoid places where impact is just beginning. Use already established well-worn sites.

5. Reduce wastes. Pack it in; pack it out. Reducing wastes helps prevent animals from becoming habituated to humans and lessens the chances of them becoming nuisances around bivouacs.

a. Reduce your litter prior to packing it.
b. Dispose of all waste items in an appropriate manner. If a trash bag is provided, use it. If none is available, pack your trash in your rucksack. Do not attempt to burn or bury trash at any training site.
c. Properly dispose of what you cannot pack out. Correctly disposing of wastes, helps prevent pollution of water sources and the spread of illness such as giardia.
d. Dispose of human waste properly. Use designated latrines only. "Cat Holes" are not authorized.

6. Leave what you find.

a. Avoid damaging trees and plants.
b. Avoid disturbing wildlife.
c. Avoid contact with wildlife

7. Fires. Minimize use and impact of fires. A fire should be viewed as a tool to be used only when necessary.

a. Do not start wood fires at any training site unless directed by an instructor.
b. If authorized, make your fire small and safe.

Table of Contents

The Operational Environment

The cadre members of the AMWS are constantly monitoring the current and anticipated future Operational Environment (OE) to ensure what we teach you today will apply to your mission tomorrow. Much of the Earth's surface is mountainous, with significant mountains found on all seven continents. These ranges form natural borders, canalize movement, affect weather patterns and can provide refuge for insurgents, smugglers and other adversarial elements.

The AMWS analyzes the global OE using PMESII-PT through our combat deployments, training missions, information exchanges, interaction with the 6 regional Combatant Commands (COCOMs) and through discussion with US and foreign military and other governmental forces. We continually review lessons learned and scrutinize our mountain warfare programs of instruction to confirm we are providing relevant training to the force. Our goal is to enable the force to fight effectively in the mountains. We create mountain Soldiers, not technical mountaineers or sport climbers. We train and equip you to move, fight, sustain and survive. Every topic we discuss is designed to better prepare you for the OE without overburdening you with excess equipment or overly technical skills you will be unable to perform later when it matters. The cadre challenges you to examine everything we teach and determine how it applies to your current job and to the OE. Do not limit your thinking only to a mountainous environment. The training, field craft, and equipment we expose you to here at the AMWS are adaptable and apply anywhere. Mountain warfare is about problem solving. Take what we teach you here and leverage it to allow your unit to accomplish its mission where ever you go in the world.

- The Cadre of the Army Mountain Warfare School

1 - Basic Mountaineering Equipment
071E9005

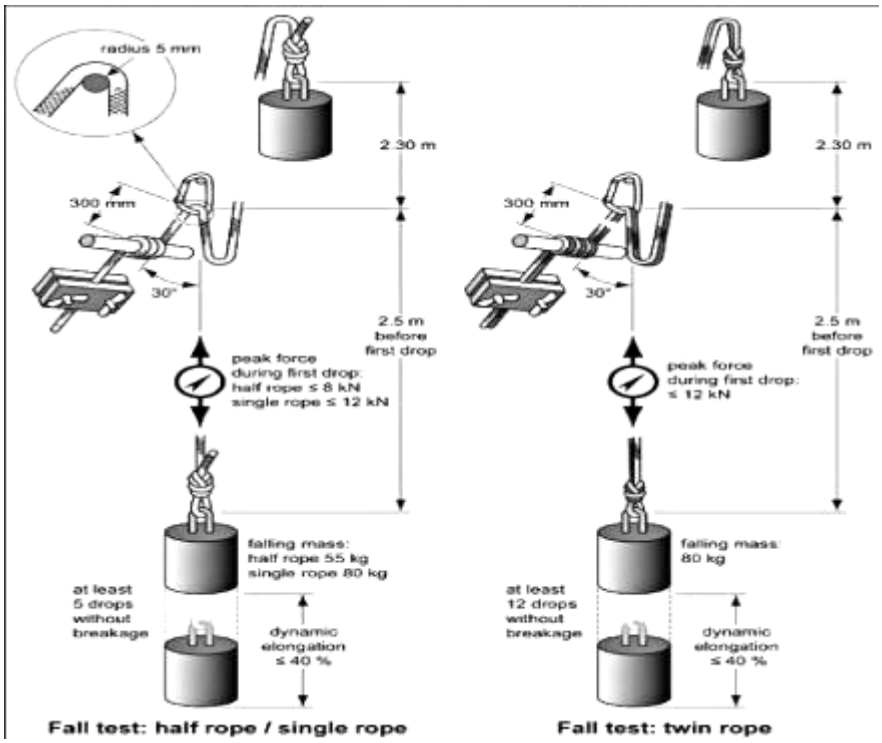
INTRODUCTION: There is a wide variety of military mountaineering equipment available both in the military system and off the civilian shelf. Like any other type of equipment used in the military it is important we not only understand its proper use but also how to properly take care of it. The consequences for not understanding and enforcing strict PMCS on your mountaineering equipment can be deadly.

a. **Identify Criteria for Selecting Ropes.** No one rope is ideal for all applications. The intended use of the rope must be examined to select the best rope for the job.

(1) Diameter. Dynamic and static ropes come in various diameters.
(a) Cord. Static, comes in sizes 5mm to 8mm.
(b) Dynamic Rope. 7.8mm to 11mm.
(c) Static Rope. 7mm to 13mm.

(2) Length.
(a) Static rope and cord generally can be purchased and cut to any desired length.
(b) Dynamic rope generally comes in 50 or 60-meter lengths and may be cut shorter.

(3) Number of Falls Held. The UIAA (French organization – Union of International Climbing and Mountaineering) develops standards for testing ropes under various conditions, as well as other standards for care and use of rope. The UIAA drop test shows how many severe falls a dynamic rope can withstand before you retire it. The number of falls the rope holds in the test is the falls held. To pass UIAA tests, a 2.8-meter (9-foot) sample of rope must sustain five falls of an 80-kilogram (176-lb.) weight without failure. The positioned weight is for a fall of 5 meters (16-feet) with the peak force not exceeding 1200 kilograms (2650-lbs.) for the first fall. Table of Contents



(4) Impact Force. Impact force is the sudden stress put on the belay chain when a fall is stopped. It is the maximum load placed on a rope after all of the energy from a fall has been absorbed in the rope's stretch.

(5) Elongation. Elongation or stretch dissipates the energy produced during a fall throughout the rope rather than directly to the climber's body or anchor system.

(6) Strength. Strength is an important safety factor when selecting a rope for a task. A military safe working load is commonly defined as 1/5th of the TENSILE STRENGTH (TS) or breaking strength of the rope. If the load on the rope were 500 lbs, it would be desirable to have a rope with TS of minimum 2500 lbs. This applies to static ropes, not dynamic ropes.

(7) Repeated Loads. During usage, ropes are often subjected to repeated loadings. The ability of a rope to withstand heavy loads without failure or loss of energy absorption capacity is valuable to the user.

(8) Fall Factors. Fall factors measures the severity of a fall. Calculate this by dividing the length of a fall by the amount of rope out from the belay point. The higher the fall factor, the greater the amount of force generated. Rope drag, intermediate protection and other factors of the safety chain reduce the fall factor.

(9) Knotability. This is the ease in tying and untying knots in the rope and the ability to hold a knot once tied.

(10) Abrasion Resistance. Abrasion resistance is dependent on the rope construction. Kernmantle ropes are more abrasion resistant than laid ropes. A static rope is more abrasion resistant than laid or dynamic due to the tightly woven outer sheath.

(11) Temperature.

(a) Heat. Heat from friction can rapidly build up to a temperature high enough to cause melting and failure. At 212 degrees F, there is a 20 to 30 percent strength loss and most ropes fail at around 290 degrees F.

(b) Cold. Ropes are often used in extremely low temperatures. If the rope is dry, low temperature has no effect on its strength. The rope does sustain a strength loss of 9 to 36% when it is wet and frozen.

Note: A Soldier or unit must constantly consider the pros and cons of weight and bulk vs. safety and versatility when selecting ropes for a mission. Generally, thinner diameter ropes have less weight and bulk when carrying; however have a decreased safety margin when loaded over sharp edges compared to larger diameter ropes. In regards to length, greater lengths will offer greater versatility for rappelling or climbing greater distances, however this comes at a price, since the additional weight and bulk cannot be distributed among the team.

Note: The service life of a rope depends on the frequency of use, applications (rappelling, climbing, rope installations), speed of descent, surface abrasion, terrain, climate and quality of maintenance given to the rope. Any rope can fail under extreme conditions (shock load, sharp edges, misuse) despite its service life.

Identify Kernmantle Ropes.

a. **Kernmantle Rope Construction.** Kernmantle or "jacketed-core" ("kern" means "core" and "mantle" means "sheath") is constructed similarly to 550-parachute cord and are the only approved ropes for military mountaineering. The internal core of the rope is constructed of a continuous multi-filament nylon yarn, which is spun into a continuous core of twisted or braided, parallel strands of nylon enclosed in a tightly woven outer sheath. While the jacket may puncture or tear in use, usually enough of the jacket remains to securely hold the core fibers. Despite this, kernmantle rope is considered far superior in design, manageability, strength and safety.

(1) **Static Kernmantle.** Static ropes are designed for rappelling, rescue operations, load hauling and rope installations. The rope has a protective sheath woven tightly over a parallel-fiber-bundle core. Due to the internal parallel strand construction of the static rope, there is less spinning and kinking than with dynamic rope.

Note: The minimum tensile strength for 11 mm (7/16 inches) static ropes for military use is 4,500 lbs / 20 kN.

Table of Contents

(2) **Dynamic Kernmantle**. A dynamic rope is designed for climbing only. The rope has a braided sheath woven over a twisted or braided-strand shock-absorber core. It is well suited for climbing, due to the elastic elongation of the rope during a fall. Dynamic kernmantle ropes have an elongation of about 40 percent at the point of failure and come in a variety of sizes, lengths, stretch factors, tensile strengths and fall ratings. The best dynamic rope is a compromise of the best blend of the following:

(a) Low-impact force.
(b) Low elongation under body weight.
(c) Flexibility.
(d) Easy to handle and lightweight.
(e) Water repellant and free of sheath slippage.
(f) High energy absorbing and abrasion resistance.
(g) It should sustain hard falls even after much use. Ropes that do not have military specifications should meet UIAA-approved standards.

Preparation for Use. New kernmantle ropes come wrapped in a clear plastic bag and have a specification tag located inside. Most ropes are factory coiled: To unwind, find the end of the rope and slowly unwrap.

Figure 2
Kernmantle Rope (shown with sheath partially removed)

Identify Types of Webbing.

a. **Description.** Webbing is a flat or tubular nylon material that ranges in widths from 9 mm (3/8 inch) to 5 cm (2 inches) and has many uses in mountaineering operations. Webbing is lighter than small diameter ropes or cords. It provides better adhesion than cord or rope whose circular cross section can cause rolling. It is well suited for runners (which extend the length of a piece of protection), slings (to carry hardware), etriers or stirrups for aid climbing, improvised harnesses, and other purposes in mountaineering. The strength of the webbing depends on its width and varies in tensile strength from 682 kg (1,500 lbs) to over 3,200 kg (7,000 lbs).

(1) **Tubular Nylon Webbing.** Tubular nylon webbing is constructed of a spiral weave with no sewn seam and has a hollow interior. It is easy to manage and holds knots well. If the intended use is known, it is better to presew slings, harnesses, runners and etriers. Sewn webbing is 10 to 15 percent stronger than knotted webbing.

(2) **Flat Nylon Webbing**. Flat nylon webbing has no separation in the webbing. It is more difficult to handle and does not hold knots as well as the tubular nylon webbing. It lies flatter than the tubular type and is not as prone to slipping or rotating. Generally, Flat Nylon Webbing is not used for mountaineering.

(3) **Spectra**. Spectra webbing consists of a blend of Spectra and Nylon fibers woven together to form webbing that has superior properties. The bonus of Spectra fiber is that it is stronger, lighter and absorbs less water compared to Nylon. The down side of Spectra is that it melts at a much lower temperature than Nylon.

b. **Maintenance.** All nylon webbing (slings, runners) should be inspected daily before, during and after use.

Table of Contents

The webbing ends should be cut with a hot knife or seared to prevent fraying. Webbing should be kept away from heat, acids, oils and solvents that can harm synthetic fibers. Rope or nylon items must not run over the top of webbing. Nylon on nylon creates friction, which can be harmful to webbing. Sharp edges must be avoided. Do not exceed the specified safe working load rating. The entire length of webbing should be inspected for cuts, frays, burns, abrasions, and worn spots. Webbing abrades quickly. If excessive wear and damage are noted, the webbing should be replaced. Like any nylon rope, webbing should be washed; air-dried and stored in a cool, dry, area out of direct sunlight.

Rope Care

a. **General Rules**

(1) Always protect your rope at potential abrasion points. When possible, use runners or pads to keep the rope away from sharp edges. Rock crystals, bolt hangers, glass and even pack grommets can cut a rope's sheath.

(2) Keep your rope clean. The best way to keep it clean is by being conscious of where you coil and uncoil it. Dirt shortens the rope life by causing internal and external abrasion.

(3) Avoid stepping on the rope and use a protective rope bag/tarp when transporting and managing it on the ground.

(4) Wash a dirty rope in cold or lukewarm water using mild soap. Do not use laundry detergent as it can strip the oils from the nylon fibers. Do not use bleach! Do not dry in a dryer! Air-dry your rope away from direct sunlight.

(5) Store your rope completely dry, free of all knots and coiled loosely away from heat sources and any chemicals. Avoid contact with any petroleum products, bleach, battery acids, and other substances that damage nylon and attract dirt.

(6) Never use a climbing rope for any purpose other than for what it was intended. It is not for towing cars, trimming trees, working on the roof, etc.

Perform Maintenance Procedures for Rope and Cord.

a. **Inspection.** Inspect your rope before and after each use. It is the user's responsibility to know the history of the rope and to determine when it should be retired. Determining when to retire a rope can be difficult but a few common sense rules will help. A rope should be retired after holding a long, hard fall, if it has flat or soft spots, becomes too stiff or shows major sheath damage. If you can see the core of the rope, it should be retired. Any time you "backstack" or "backfeed" your rope is a great time to inspect it, simply by running your hands along it and feeling for any bumps or soft spots, anything that might indicate damage to the core. Retire a rope after no more than four years of occasional use, two years of weekend use or one year of regular active use. Retiring a rope after only six months of hard use is not uncommon; some climbing gym ropes wear out after only a few weeks of intense use. The bottom line is "When is doubt, throw it out! " In many cases, lead climbing ropes that have been retired due to number of falls held are still adequate for top roping, rappelling, fixed ropes and other uses that don't require a great deal of dynamics. Damaged ropes should be cut up to avoid being used again accidentally.

b. **Record Keeping.** Static ropes and dynamic ropes must not be interchanged. Ropes should be color-coded or marked to identify its use (leader climbing rope, rope installation or rappelling rope). A log should be maintained for each rope indicating the dates, use, weather condition and duration of use. Portions of unserviceable ropes may be salvaged for use as sling ropes.

c. **Maintenance Schedule.** The rope should be inspected daily, before, during and after use. The ends should be fused, whipped or taped to prevent unraveling. Ropes should be kept away from insect repellent, oils, acids, solvents and corrosives that can harm synthetic fibers. The entire length should be inspected for burns, cuts, frays, dirt and damage.

Table of Contents

d. **Washing.** Ropes should be periodically washed to remove the buildup of dirt inside the lay or sheath. Many companies market a rope washer, which is a short length of modified pipe connectable to any standard faucet. Pinholes within the pipe force the water to circulate around and scrub the rope as it is fed through the washer by hand, inches at a time. Another method is to machine wash, on gentle cycle, in cold water with a nylon safe soap. Air-dry the rope out of the sun by hanging in lazy loops. Care must be taken to insure that mechanical cutting or fraying from the washing machines agitator does not occur during the washing process. In addition, daisy chaining the rope will prevent it from becoming tangled.

Perform Maintenance Procedures for Carabiners.

a. **Description**. Carabiners can be steel or aluminum, oval, d-shaped, bent, and straight or wire gate.

b. **Inspection.**

(1) Inspect closely for cracks and flaws in the metal. Be certain gates open and close smoothly without binding.

(2) There should be good side-to-side rigidity in the gate when it is open.

(3) Check gate pins to see that they cannot work out of the holes.

c. **Maintenance.**

(1) Many sticky gate problems are the result of burrs that develop on the moving parts after hard use. With care, the burrs can sometimes be lightly filed.

(2) Used carabiners sometimes start to close off center. If this happens, the carabiner is probably bent and should be replaced.

(3) Never use oil on your carabiners; it will attract dirt and clog the gate. Instead, use a dry, graphite-based lubricant.

Perform Maintenance Procedures for Belay/Rappel Device.

a. **Description.** Belay/Rappel devices can be made of either steel or aluminum.

b. **Inspection.** Check the device for grooves or burrs. File the burrs smooth if necessary.

c. **Maintenance.** Wipe down to remove dirt and grime when needed.

Note: If the device has deep grooves or sharp edges, turn in for a newer one.

Perform Maintenance Procedures for Ascenders.

a. **Description.** Designed for ascending fixed single ropes from 8 – 13 mm.

b. **Inspection.** Check aluminum alloy body to ensure there are not any cracks, and the spring loaded toothed cam operates freely.

c. **Maintenance**. Keep clean, wash with warm water. Avoid contact with petroleum products.

Identify Breaking Strengths of Equipment.

Breaking Strengths. The following is a list of general breaking strengths of mountaineering equipment that is issued in the military system or allowed to be locally purchased. Strengths vary between manufacturers and from year to year based on design changes. Carabiner strength is given in kilonewtons (kN), a measurement of force based on UIAA testing. Those given are with the gates closed. Table of Contents

Note: 1 kN = 225 lbs.

ITEM	BREAKING STRENGTH
11mm dynamic rope	10-fall rope, 9 kN impact force
11mm static rope	30 kN
1" tubular nylon webbing	18 kN
7mm cord	11 kN
Non-locking oval carabiner	22-30 kN
Non-locking d-shaped carabiner	31 kN
7/16" steel locking carabiner	53 kN
Pear-shaped locking carabiner	22-30 kN

Identify the Features of a Commercially Manufactured Harness.

a. Identify a Manufactured Harness.

(1) Harness is made from sewn flat webbing.

(2) Sewn tie in loop at front center of harness is used for all harness operations.

(3) Buckles are speed version – they are pre-double passed for safety purposes.

PMCS a Commercially Manufactured Harness.

a. Maintenance for Commercially Manufactured Harnesses.

(1) Keep your harness out of direct sunlight, as ultraviolet rays weaken the nylon fibers.

(2) Keep your harness away from excessive heat

(3) Inspect the harness before and after each use for excessive wear, cuts, burns or the presence of petroleum or chemicals.

(4) Inspect the stitching for weak points or damage.

(5) Inspect the buckles for sharp edges or damage.

(6) Cleaning.

(a)Wash it with a chemical-free detergent.

(b)Allow to air dry out of direct sunlight.

(7) Storage: Store in a cool, dark, well-ventilated area.

(8) Retire a harness after it has taken an excessively long fall or when it begins to show wear: Particularly in the stitching. Nylon naturally weakens with age.

Note: If you note any of these problems, replace the harness.
Note: Do not use the harness after a severe fall.

b. Safety.

(1) Do not wear knives or other items on your belt while wearing a harness.

(2) Double pass all buckles on a commercial harness (if applicable).

(3) Lock all locking carabineers.

(4) Inspect your harness frequently.

Maintain an Ice Axe.

a. **Description.**

(1) *Importance.* The ice axe is one of the most versatile and important pieces of mountaineering equipment that a Soldier has. Without it, safe alpine travel is severely restricted. The axe is an important part of balance, step cutting, probing, self-arrest, belays, anchors, ascending and descending snow and ice covered routes.

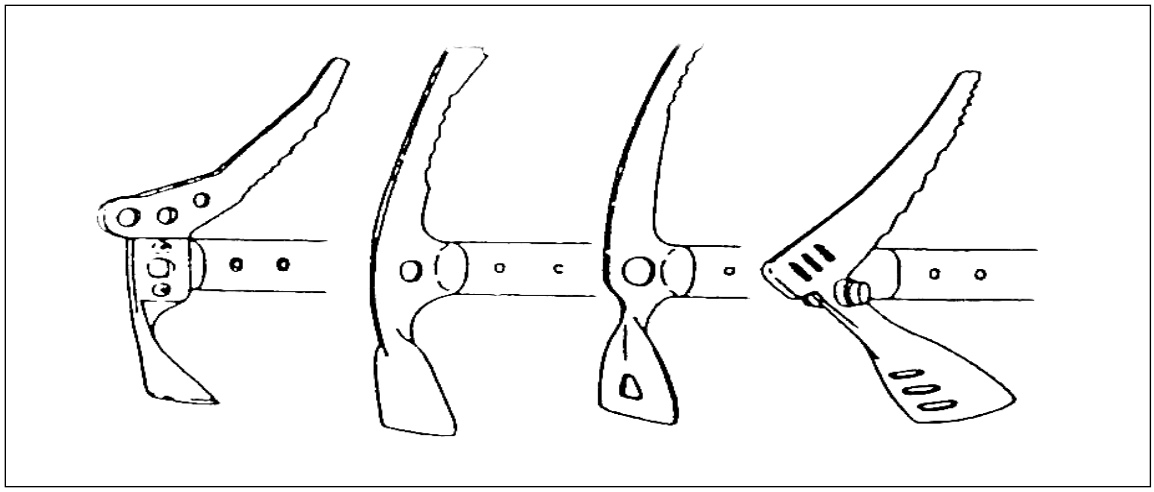
(2) *Design.* The design of an axe is often a tradeoff between features that make the tool better for specific uses. A longer axe (up to 90cm) is ideal for cross country travel, scrambling, glacier travel and the one axe technique on low angle ice and snow. As the ice slope gets steeper the axe length gets shorter (45-50 cm). Other design features become more specialized, such as the droop of the pick, placement of the teeth, shape of the adze and the curves in the shaft.

(3) *Ice Axe Parts.*

(a) Head. The Head of an ice axe includes the pick, the adze or hammer. It is made of steel and has a hole to attach a leash.

(b) Pick. The Pick is curved or drooped, to provide better hooking action on snow or ice. This design causes the axe to dig in faster when you are trying to stop yourself (self-arrest) after a fall. A moderate hooking angle of 65-70 degrees from the shaft is designed for general mountaineering use. A sharper angle of 55-60 degrees is better for technical ice climbing. Teeth on the pick provide grip for ice and hard snow.

Table of Contents



(c) Adze. The Adze of the axe is for step cutting on hard snow or ice and to chop through the upper layers of rotten ice when setting ice screws. Adzes may be flat or curved, straight edged or scalloped, straight out or drooped. Most general-purpose ice axes come with an adze on the head. Shorter technical ice tools (used in pairs) come with an adze on one end and a hammer on the other for pounding in protection.

(d) Shaft. The Shaft will most likely be metal, a composite (fiberglass, Kevlar, or carbon filament) or a combination. Wooden shafts have become obsolete. The newer materials have greater strength and durability with less weight.

(e) Spike. The Spike is important when using the axe as a cane for balance on low angle rock, snow and ice and when plunging the axe into the snow for use as an anchor.

(f) Leash. The Ice Axe Leash provides a way to attach the ice axe to your wrist or harness. The leash is protection against dropping or losing the axe especially during a self-arrest or crevasse fall. Make the leash out of ½ or 1 inch webbing. It can be secured to the ice axe with a water knot through the hole in the head of the axe. Make a fixed loop (double overhand) in the other end large enough to accept a gloved or mitten hand. Adjust the length so that your gloved hand can grip the shaft just above the spike.

b. **Maintenance.** Modern metal-shaft ice axes need little special care, but should be inspected before and after each use.

(1) *Daily PMCS*.

(a) Check the shaft for dents, bends or cracks.

(b) Inspect the leash for cuts, frays and proper length. Check the knots and maintain minimum four-inch pigtails.

(c) Ensure the pick, adze and spike are sharp and not bent or deformed.

(d) Ensure the pick; adze and spike are securely attached to the shaft.

(2) *Repair.* None. Turn in when needed.

(3) *Storage.*

(a) Place rubber protectors on the pick, adze and spike when not in use.

(b) Wipe down after each use and remove any rust.

Note: DO NOT USE ELECTRICAL GRINDERS to sharpen the pick or adze. The heat generated will take the temper out of the metal greatly weakening the tool. Sharpen the pick from the sides toward the tip with a file held at a 20-degree angle. Sharpen the adze from the underside only.

Table of Contents

Maintain Crampons.

a. **Description.** Crampons are worn to prevent slipping while moving over snow or ice covered terrain. As with ice axes, different crampon designs involve a tradeoff between what is good for general alpine use and what is good for technical ice climbing. Most crampons are chrome-molly steel and have ten bottom points and two front points. The main choices are between hinged and rigid: Strap-ons and step-ins.

(1) *Hinged vs. Rigid.* Rigid crampons are mainly for technical ice climbing. For most mountaineering, hinged crampons are preferable. They are compatible with most military and civilian boots. If attached to a full shank or plastic boot, they work nearly as well as rigid crampons on technical ice. When attached to a flexible boot they allow the foot to flex naturally with each step.

Note: Wearing rigid crampons with flexible soled boots may cause the crampons to fall off the boots or break the crampons.

b. **Adjustment.** To ensure crampons stay attached and work properly, it is essential that they fit correctly. Follow these guidelines:

(1) Adjust crampons to the boots you will be using. Refit if you change boots.

(2) When wearing gaiters with step-in bindings ensure the rand of the gaiter does not interfere with the fit of the bail in the welt of the boot.

(3) The front points should extend between 3/4 and 1 inch beyond the toe of the boot.

(4) With step-in bindings, ensure the toe bail has full contact with the toe welt. You may need to bend the toe bail to accomplish this.

(5) The heel bail should "click" into place firmly. The heel bail should be centered and make full contact with the welt of the boot.

(6) Some climbers place a flat piece of foam, shaped like the boot sole, between the boot and the crampon to insulate the foot from the snow or ice. If you want to do this, remember to fit the crampon with the foam in place.

c. **Maintenance.**

(1) *Daily PMCS.*

(a) Check all nuts and bolts frequently and tighten as necessary.

(b) Check all rivets, straps and buckles and replace or repair as necessary.

(2) *Repair.*

(a) Keep the four front points sharp. Use will dull the points. Careful filing will sharpen the points and reduce the possibility of a slip or fall. Lightly file down the tops of the front points. File the other points on the edges.

Note: DO NOT use power grinders to sharpen your crampons.

Table of Contents

Figure 9
Correct Points to Sharpen

(b) Remove any rust with emery cloth or steel wool and wipe down with CLP (avoid getting CLP on the straps).

(c) You may tape a piece of plastic to the underside of the crampons to help prevent snow buildup.

(3) *Storage*. Store the crampons with rubber protectors on in a cool dry location.

Maintain Snowshoes.

a. **Description.** The MSR Denali Ascent snowshoe is made out of a durable, lightweight plastic. The bottom is molded to provide additional braking ability. A hardened steel crampon and lateral traction bars provide for secure footing on all but the steepest slopes. It is not meant to replace a true crampon.

b. **Binding Adjustment.** The binding is made up of four multi- position rubber straps that secure the boot to the flexible foot bed. Avoid over-stretching the rubber straps to prevent breakage and prolong service life. The pull-tabs of the straps will be to the outside of the foot after securing the boot.

c. Maintenance.

(1) *Daily PMCS.* Inspect the snowshoes before and after each use. Look for bent front crampon points. Check for cracks in the metal foot bed. Check that the small split ring and pin at the pivot point are still in place. Check rivets on binding fabric to see that they are not pulling through.

(2) *Repair.* Carefully straighten bent front crampon points with pliers as needed.

(3) *Storage.* When not in use, snowshoes should be placed in temporary racks, hung in trees or placed upright in the snow.

d. Misc.

(1) Avoid drops or bridging small streams or logs to prevent unnecessary damage to the snowshoe

(2) A televator© heel lift can be brought up to the locked position to ease strain on calf muscles during steep climbs. The televator© can be adjusted forward or back to place it directly under the heel. A tool may be needed to reposition the spring steel bail, which stows flat when not in use.

(3) An 8” tail can be added to the snowshoe to provide additional floatation by means of the two fixed posts on the snowshoe, and a captured tightening nut on the tail. Simply line up the slots in the tail over and down on the pins in the shoe and slide forward until seated firmly and tighten nut down. The maximum design load is around 275lbs using the snowshoe with an 8” tail.

Maintain Ski Poles.

a. **Ski Poles - Description.** The life link pole is a two section adjustable pole. There is an expansion sleeve in the upper part of the pole, while the bottom section has a threaded part those mates with the sleeve. When tightened, the expansion sleeve does not rotate in the oval upper section of the pole. The life link pole also serves as a two-meter avalanche probe by threading the bottom section together and removing the baskets.

Table of Contents

b. **Ski Poles - Adjustment**.

(1) *Length.* Size the pole length to the Soldier's height. Place the handgrip on the floor to measure the poles. Stand flatfooted with a pair of plastic mountaineering boots on. The basket on the pole should be at approximately armpit level.

(2) *Wrist Strap*. Adjust the wrist strap on the pole to allow the hand up through the strap and down with the strap between the thumb and first finger. Adjust pole straps for both the right and left hand.

c. **Ski Poles - Maintenance**.

(1) *Daily PMCS*. Ensure poles are clean, free from burrs and in good condition. Insure the lock washer is in place below the basket. Basket should not be torn or missing large amounts of material.

(2) *Storage.* Poles should be matched, cleaned, repainted and repaired. Store them in a cool dry place

Maintain Artificial Ice and Snow Protection.

a. Description. Ice screws, ice pitons, dead-men and pickets provide artificial protection for climbers, rope installations and anchor systems in ice or snow covered terrain. There are many different types available.

(1) *Ice screws*. Made of chrome-molly or stainless steel and usually range in size from 11 to 22 cm. They are threaded to screw into and out of the ice. The center of the screw is hollow forming a tube shape to allow the displaced ice to move up inside the screw itself. The eye (to attach a carabiner) is permanently fixed to the top of the shaft. The tip has three or four teeth that cut the ice as the screw is turned. The ice screw has a right-hand thread. Sometimes ice screws are difficult to start and once started may be difficult to turn. On the plus side, they are usually easy to recover. They are also reusable if undamaged.

(2) *Dead-men.* The wired snow anchor (dead-men) provides security for climbers in areas where ice protection is inadequate. The dead-men are constructed out of aluminum. The wired portion is made either out of galvanized or stainless steel.

(3) *Pickets.* The snow picket is used in constructing anchors in snow and aerated ice. The snow picket is made of a strong aluminum and drilled to accommodate carabiners.

b. Maintenance.

(1) *Daily PMCS.* Inspect ice protection for cracks, bends and other deformities that may impair strength and function. Ensure there are no cracks around the eye and that all welds are intact. Keep ice protection as clean and dry as possible while conducting operations. Care for pickets and dead-man in much the same fashion as screws. Pickets are pound-in protection, and they are often bent. If the bend is radical or if you cannot easily straighten it, turn the item in. Check the cable on dead-man for cuts or frays. If any cracks, broken wire strands or slippage in the wire through the swage is noticed, it should be turned in. The snow picket should be inspected for bends, chips, cracks, mushrooming ends and other deformities. The ends should be filed smooth. If bent or cracked, it should be turned in for replacement.

(2) *Repair*. Keep the teeth of the screws sharp and free of burrs with a file. If you cannot correct any deficiencies, turn in the screw. Remove any rust found with steel wool. Once screws are removed from the ice they cannot be reused until the ice inside has been removed. Remove the inside ice by gently taping the piece on the sole of your boot, by using a small piece of coat hanger carried on the rack or using your ungloved hand to warm the piece (least preferred).

(3) *Storage.* Ensure they are dry, then lightly coat with CLP for storage.

Perform Racking Techniques for Individual Climbing Equipment.

a. **Basic Military Mountaineering Rack** consists of the following:

(1) Belay/Rappel Device
(1) Pearabiner
(6) Non-locking carabiners
(3) 1 x 24 inch tubular webbing
(3) 7mm x 18 feet utility cord
(1) 11mm x 18 foot sling rope
(2) Steel locking carabiners
(1) 9/16 x 24 inch tubular webbing

(1) Mechanical Ascender Table of Contents

b. **Racking the Equipment.**

(1) Tie a loop with the 9/16 black tubular webbing. This will be the webbing all of the equipment is placed on. Ensure the knot has 4" pigtails.

(2) Clip the Omega SBG (rappel/belay device) onto a carabiner along with the mechanical ascender.

(3) Tie each piece of the 1 x 24 inch webbing together using a water knot. Coil these up individually and place them on one non-locking carabiner. Clip this onto the black piece of webbing.

(4) Coil the 7mm x 18 foot utility cord individually. Two of the cords should be pre-joined with a Figure 8 Bend knot. Place them on one carabiner. Clip this onto the black piece of webbing.

(5) Coil the 11mm x 18 foot sling rope. Place this on one carabiner.

(6) With the remaining carabiners, clip two onto one, and then clip the one to the rack.

(7) Clip the pearabiner to the black piece of webbing with nothing on it.

(8) Chain the two locking steel carabiner together, then attach them to the rack.

c**. Equipment Order** (all placed on the black piece of webbing).

(1) Pearabiner and Lockers up front.

(2) Extra carabiners.

(3) Utility Cords.

(4) Webbing.

(5) Belay/Rappel Device with Mechanical Ascender.

(6) Sling Rope.

Notes:

Table of Contents

2 - Basic Knot Tying

071E9002

INTRODUCTION: The ability to quickly tie knots correctly under stress and in difficult conditions such as limited visibility or extreme cold is crucial for any unit conducting military mountaineering. Knot tying is the critical task in constructing rope systems and conducting technical movement. Soldiers must understand the strengths and weaknesses of each knot and to which application they are best suited.

a. **Basic Knot Considerations**.

(1) Knot. A knot is a temporary condition in the rope. Knots have the ability to untie themselves over a period of time. A permanent knot would be desirable, but no such knot exists. All knots must be repeatedly checked and often re-tied.

(2) Adverse Conditions. Often there is a need to tie a knot under adverse circumstances. You must know which knot is best for the purpose intended and how to tie the knot well. Repeated practice is recommended.

(3) Selection. Strength should not be the sole basis of knot selection. Ease of tying, untying after loading, chances of working loose, and allowance for quick inspection are all factors.

(4) Strength of Knots for Single Kernmantle Rope.

No Knot: 100%	Overhand: 60% to 65%
Clove Hitch: 60%to 65%	Bowline: 70% to 75%
Water Knot: 60% to 70%	Two Half Hitches: 60% to 70%
Figure Eight: 75% to 80%	

b. **Terms used in rope work**.

(1) Bight: A bend in the rope in which the rope does not cross itself.

(2) Double Bight: A bend in a doubled rope in which the ropes do not cross themselves.

(3) Loop: A bend in the rope in which the rope crosses itself.

(a) Overhand Loop: The running end over the standing end.

(b) Underhand Loop: The running end under the standing end

(4) Half Hitch: A loop that runs around an object to lock or secure itself.

(5) Girth Hitch: A bight around an object securing the standing ends.

(6) Running End: Loose or working end of the rope.

(7) Standing End: Stationary or non-working end of the rope.

(8) Turn: A wrap of the rope around an object, providing 360-degree contact

(9) Round Turn: A wrap of the rope around an object 1 1/2 times. You can use it around small diameter trees to prevent the rope from sliding up from the base.

(10) Pigtail: The pigtail is the portion of the running end after the safety knot and the end of the rope. All pigtails will be a minimum of 4 inches long. Table of Contents

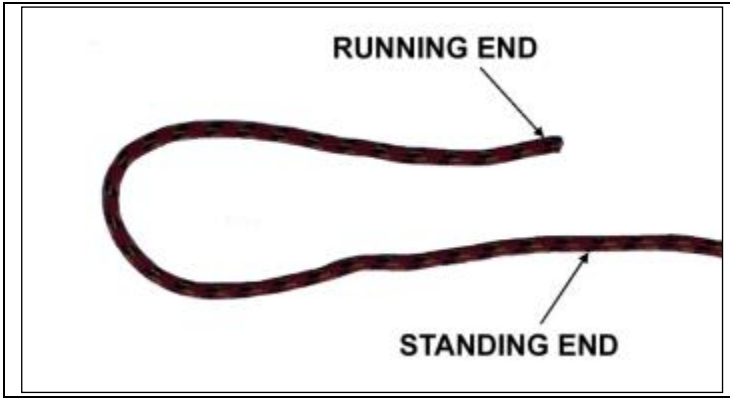


Figure 1
Over Hand Loop

Figure 2
Under Hand Loop

Figure 3
Half Hitch

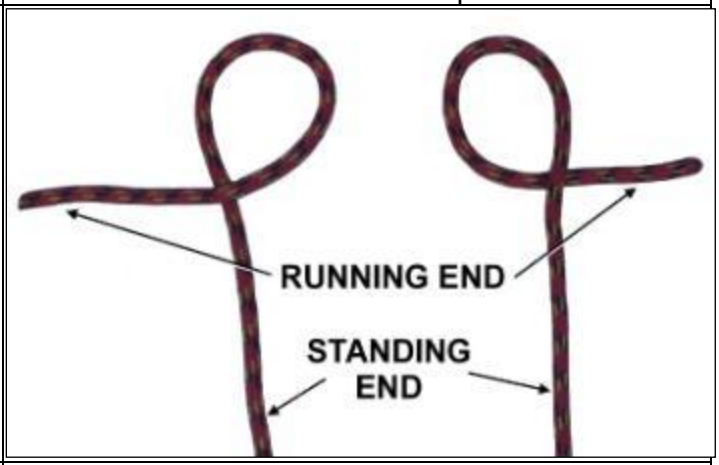


Figure 4
Running and Standing Ends

Note: For standardization and ease of inspection, always tie right to left for horizontal anchors or top to bottom for vertical anchors.

a. KNOTS

(1) OVERHAND KNOT.

(a) Purpose: To be used as a safety knot.

(b) Tying the Knot:

- Take the running end of the rope and form a loop.
- Place the running end through the loop.
- Dress the overhand knot down to the knot that it is securing.

(c) Checkpoints:

- A locking bar that secures the running end to the standing end.
- Minimum 4-inch pigtail

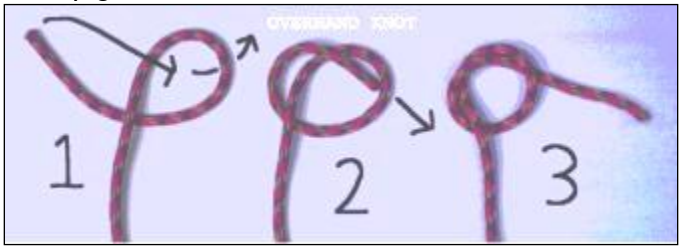


Figure 7
Overhand

Table of Contents

(2) GIRTH HITCH.

(a) Purpose: To attach a piece of webbing or cord to an anchor or into a harness.

(b) Tying the knot:

- Take a pre-tied piece of tubular webbing and place a bight over the anchor or harness. The joining knot should be offset.
- Pass the knotted side of webbing through the bight.
- Dress the wraps and locking bar down ensuring the joining knot is offset and out of the girth hitch.

(c) Checkpoints

- Two turns around the object with a perpendicular locking bar.
- The joining knot is offset and out of the turns.

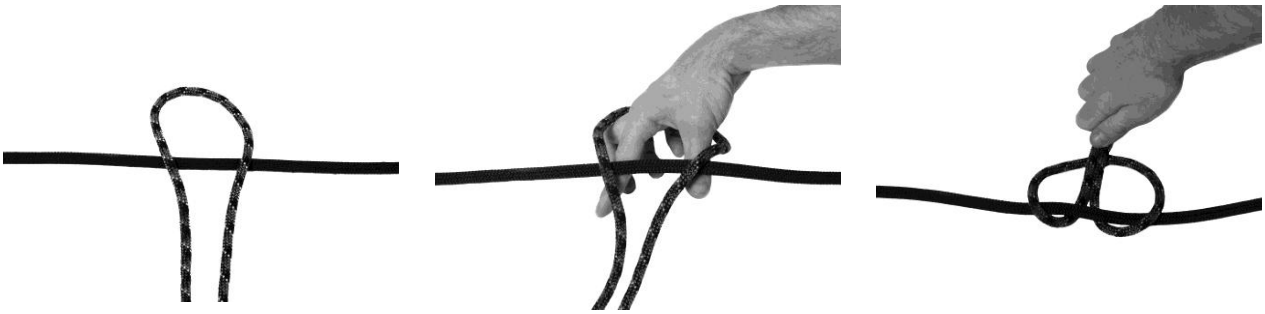


Figure 8
Girth Hitch

(3) SQUARE KNOT.

(a) Purpose: To join the ends of two ropes of equal diameter when they are under tension.

(b) Tying the Knot:

- Holding one running end in each hand, place the running end in your right hand over the one in your left hand.
- Pull it under and then back over the top of the rope in your left hand.
- Place the running end in your left hand over the one in your right hand and repeat as in Step 2.
- Dress the knot down and safety it with an overhand knot on each side of the square knot.

(c) Checkpoints:

- Two interlocking bights.
- The running ends are on opposite ends of the knot and on the same side of the standing ends.
- Minimum 4-inch pigtails after the overhand safety.

Table of Contents

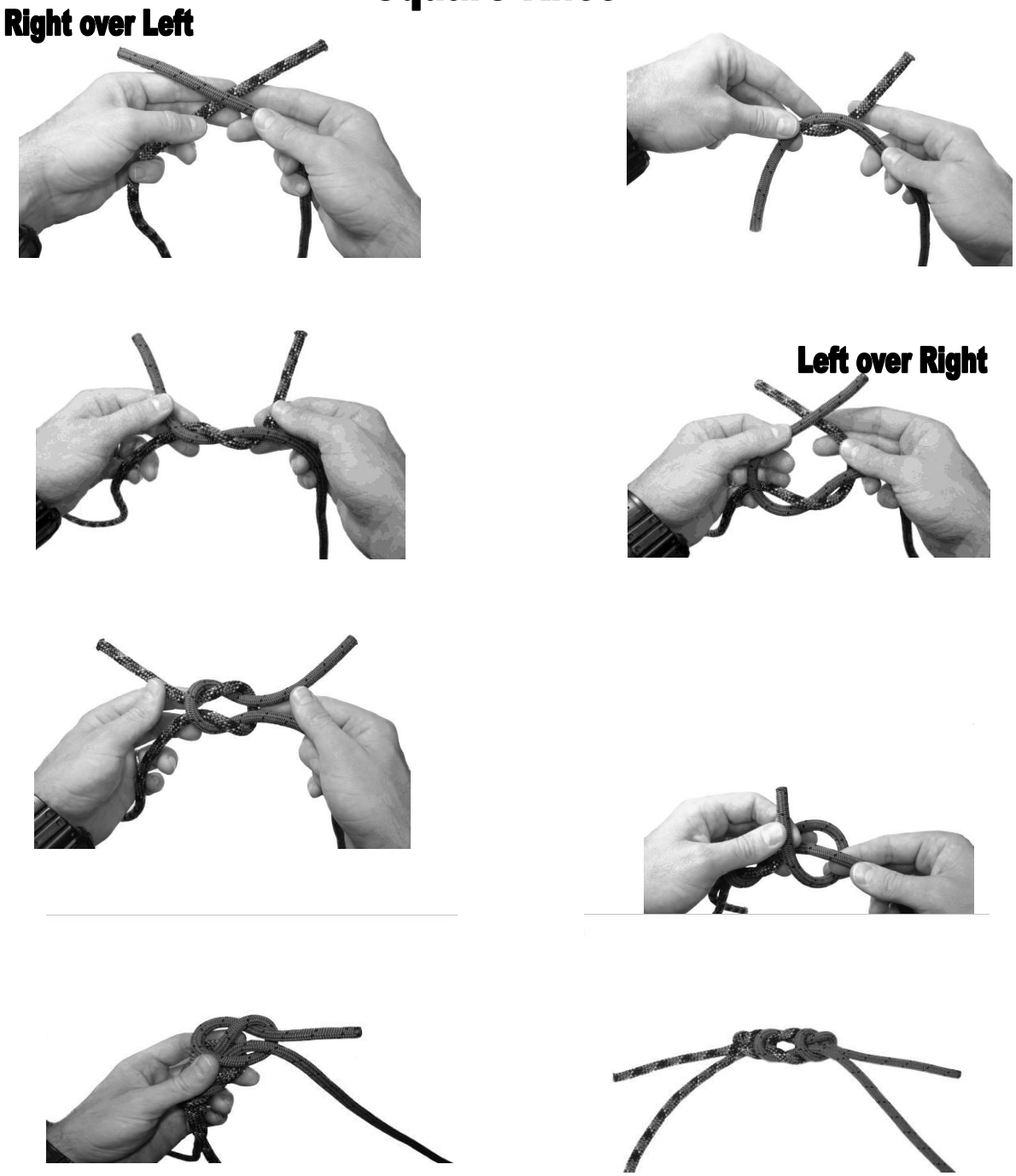


Figure 8
Square Knot

Table of Contents

(4) FIGURE EIGHT BEND.

(a) Purpose: To join the ends of two ropes up to a 5-mm diameter difference.

(b) Tying the Knot:

- Grasp the top of a 2-foot bight.
- With the other hand grasp, the running end (short end) and make a 360-degree turn around the standing end.
- Place the running end through the loop you have just formed creating an in-line figure eight.
- Route the running end of the other rope back through the figure eight starting from the original rope's running end. Trace the original knot to the standing end.
- Remove all twists and crossovers. Dress the knot down.

(c) Checkpoints:

- Two ropes running side by side in the shape of a figure eight.
- The running ends are on opposite ends of the knot and on opposite sides of the standing ends.
- Minimum 4-inch pigtails.

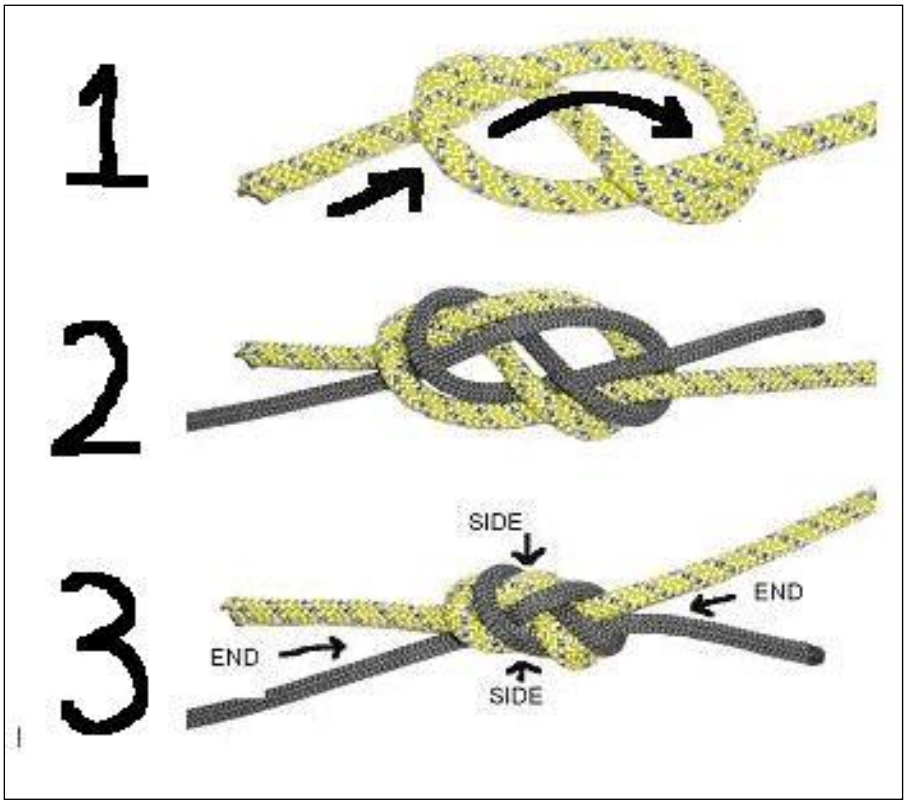


Figure 9
Figure Eight Bend

Table of Contents

(5) WATER KNOT.

(a) Purpose: To join the ends of tubular webbing.

(b) Tying the Knot:

- Tie an overhand knot in one end of the webbing.
- Route the other end of the webbing back through the overhand knot. Follow the course of the original overhand knot.
- Ensure all the webbing is laying flat within the knot.
- Dress the knot down.

(c) Checkpoints:

- Two pieces of webbing running side by side in the shape of an overhand.
- The running ends are on opposite ends of the knot and on the same side of the standing ends.
- There are no twists in the webbing.
- Minimum 4-inch pigtails.

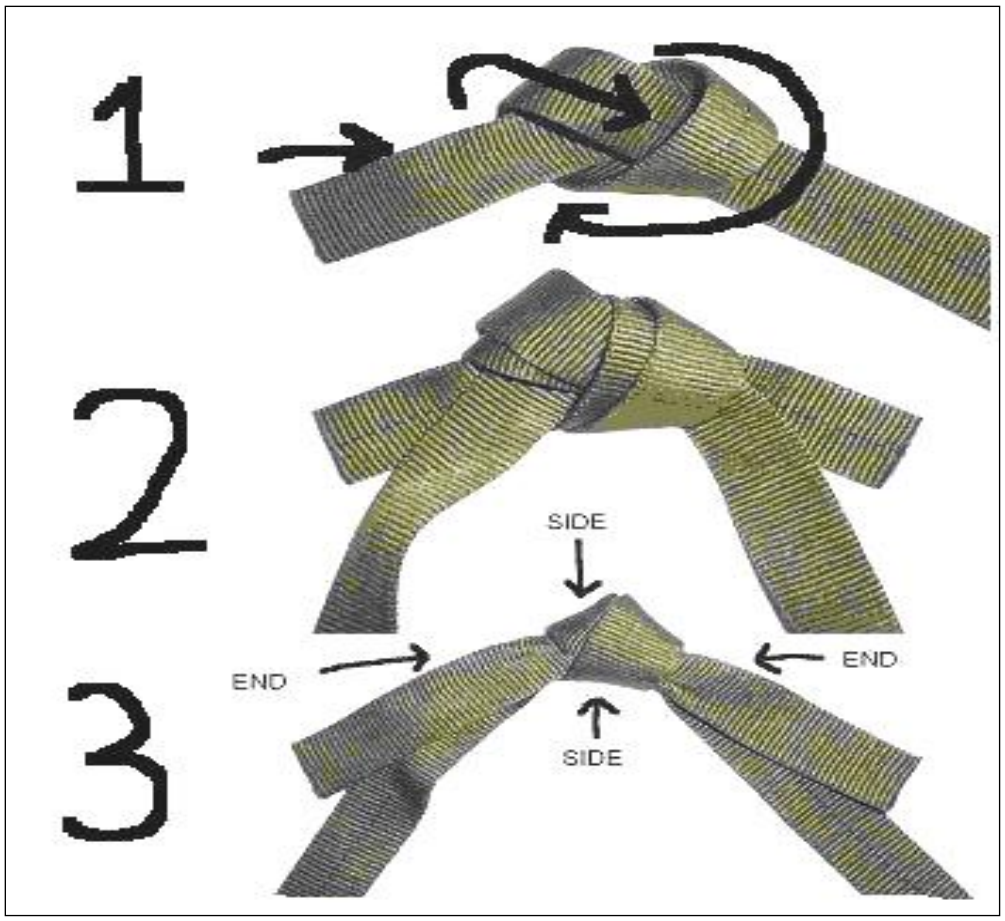


Figure 10
Water Knot

Table of Contents

(6) BOWLINE.

(a) Purpose: To anchor the end of a rope.

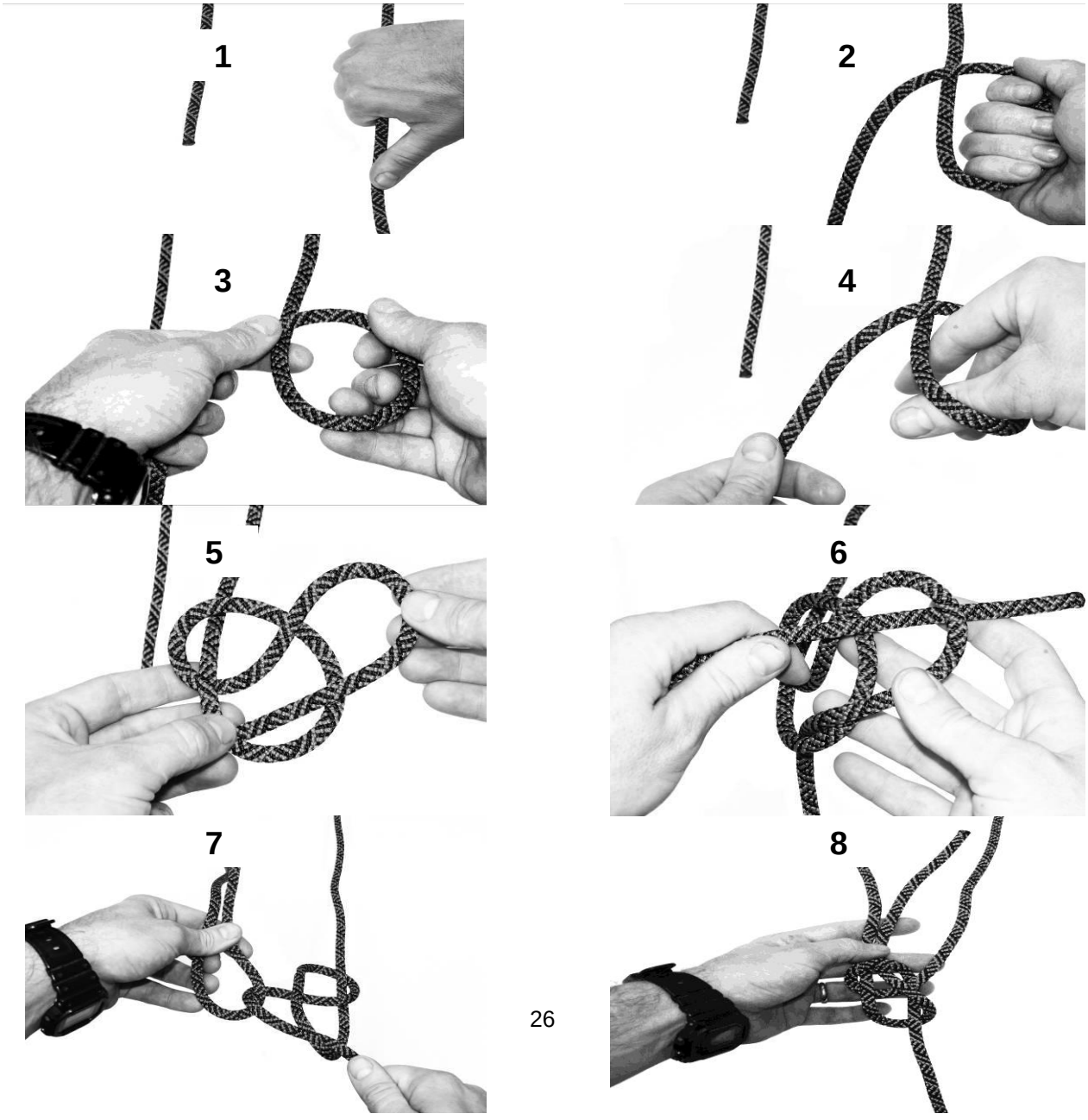
(b) Tying the Knot:

- Bring the running end of the rope around the anchor, from right to left, top to bottom.
- With your right thumb facing toward you, form a loop in the standing part by turning your wrist clockwise. Lay the loop to the right.
- Reach down through the loop with your right hand. Pull up a bight from the standing part of the rope. Ensure the standing part of the bight is facing toward you.
- Place the running end of the rope (on your left) through the bight from left to right and bring it back on itself. Hold the running end loosely and dress the knot down by pulling on the standing end.
- Dress the knot down and safety the bowline with an overhand knot.

(c) Checkpoints:

- A bight around the standing end, held in place by a loop.
- The running end of the bight is on the inside of the fixed loop.
- Minimum 4-inch pigtail after the overhand safety.

Table of Contents



(7) TRIPLE BOWLINE.

(a) Purpose: To anchor a bight of rope.

(b) Tying the Knot:

- Form a bight. Bring the running end of the rope around the anchor, from right to left top to bottom.
- With your right thumb facing toward you, form a doubled loop in the standing part by turning your wrist clockwise. Lay the loops to the right.
- With your right hand, reach down through the loops and pull up a doubled bight from the standing parts of the rope. Ensure that the standing parts are facing toward you.
- Place the running end (bight) of the rope (on your left) through the doubled bight from left to right and bring it back on itself. Hold the running end loosely and dress the knot down by pulling on the standing ends.
- Safety it off with a doubled overhand knot.

(c) Checkpoints:

- Two bights around the two standing ends, held in place by two loops.
- The running end of the double bight is on the inside of the fixed loops.
- Minimum 4-inch pigtail after the overhand safety.

Figure 29
Triple Bowline

Table of Contents

(8) CLOVE HITCH: End of rope (EOR).

(a) Purpose: To anchor the end of the rope under tension.

(b) Tying the Knot:

- Make a turn around the anchor, left to right.
- Bring the rope over the standing part and down continuing around the anchor forming a diagonal locking bar.
- Continue wrapping around the anchor.
- Pass the running end under the locking bar just formed.
- Dress the knot down.

(c) Checkpoints:

- Two turns around the anchor with the diagonal locking bar in the opposite direction of pull.
- The running and standing ends exit from the middle of the knot.

Table of Contents

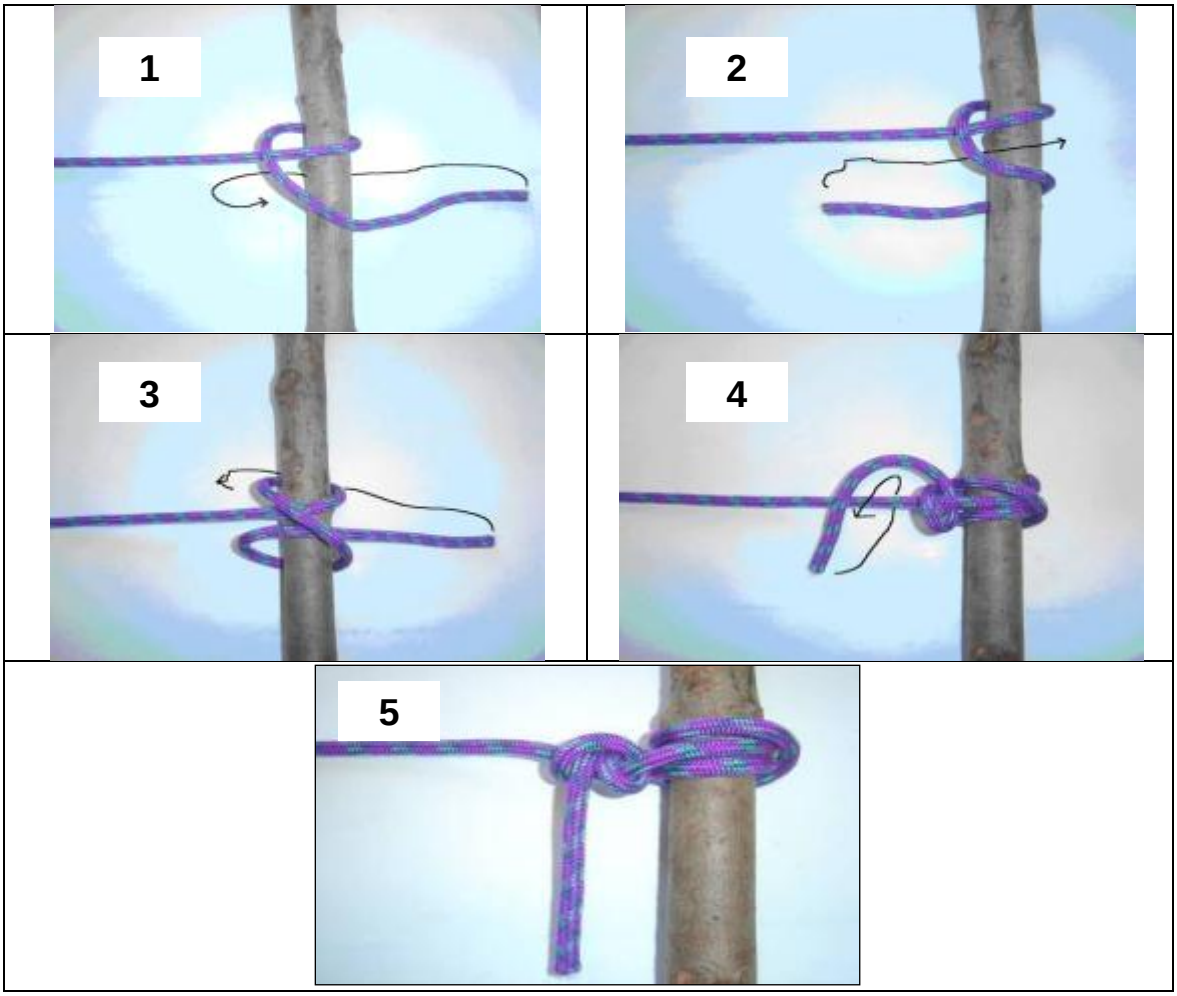


Figure 16
EOR Clove Hitch

Table of Contents

(9) CLOVE HITCH: Middle of the rope (MOR).

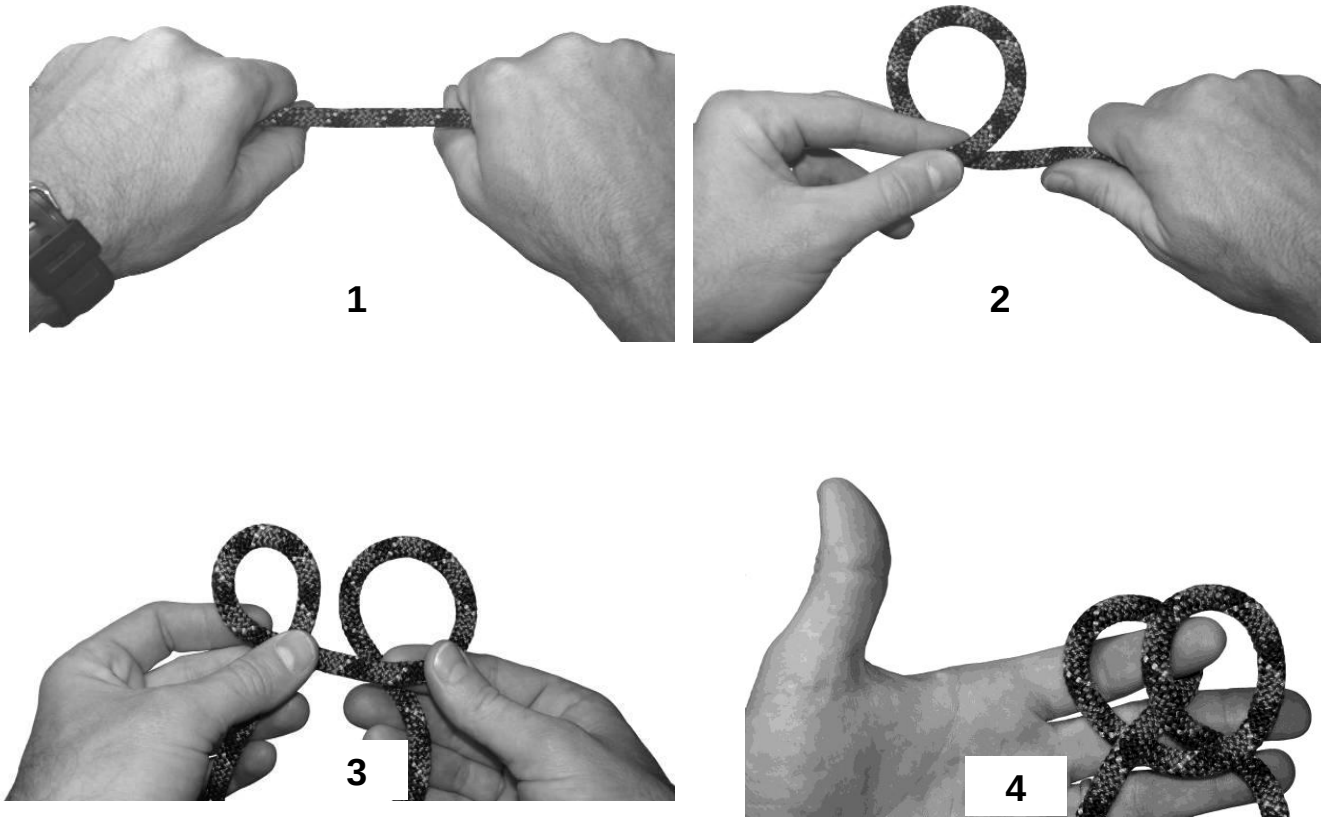
(a) Purpose: To form an anchor in the middle of a rope.

(b) Tying the Knot:

- Hold the rope in both hands, palms down about 12 inches apart.
- With the right hand, form a loop away from your body toward the left hand. Hold the loop with the left hand.
- Again, with the right hand, form a loop away from your body toward the left hand. Hold the loop with the right hand.
- Place the second loop on top of the first loop that you formed without flipping it.
- Place both loops over the anchor and pull both ends of the rope in opposite directions.

(c) Checkpoints:

- Two turns around the anchor with a diagonal locking bar.
- The running and standing ends exit from the middle of the knot.



Middle of the Rope Clove Hitch

Table of Contents

(10) DOUBLE FIGURE EIGHT.

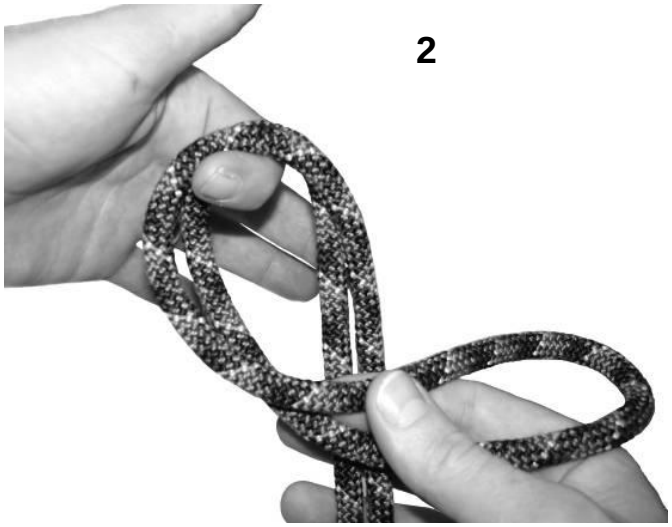
(a) Purpose: To form a fixed loop in a rope.

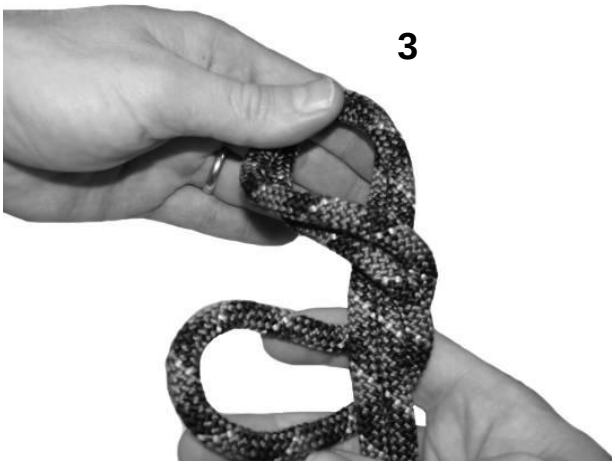
(b) Tying the Knot:

- Form a 12-inch bight.
- With the bight, make a 360-degree turn around the standing end forming a doubled loop in your hand.
- Place the bight through the loop.
- Remove all unnecessary twists and crossovers. Dress the knot down.
- (VARIATION): A Doubled Double Figure Eight is tied the same, but with a doubled rope.

(c) Checkpoints:

- Two ropes running side by side in the shape of a figure eight.
- The knot forms a fixed loop.
- Minimum 4-inch pigtail when tied at the end of the rope.





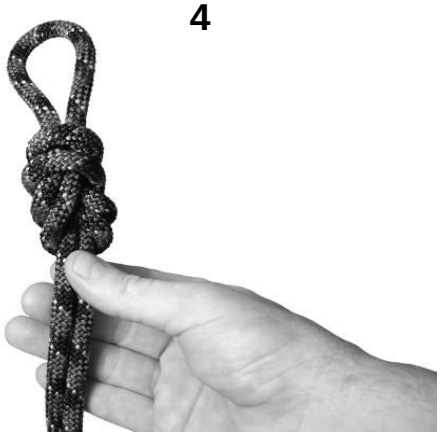


Table of Contents

(11) FIGURE EIGHT SLIP KNOT.

(a) Purpose: To form an adjustable bight in a rope.

(b) Tying the Knot:

- Take a bight in the rope. Holding the closed end, grasp the doubled rope below the bight with the opposite hand. Make two twists in the bight (360 degrees) with the top hand.
- Maintaining the two twists, reach through the loop and pull a bight through the loop in your hand.
- Dress down the knot.

(c) Checkpoints:

- The knot is in the shape of a figure eight.
- An adjustable bight passes through one loop of the figure eight.

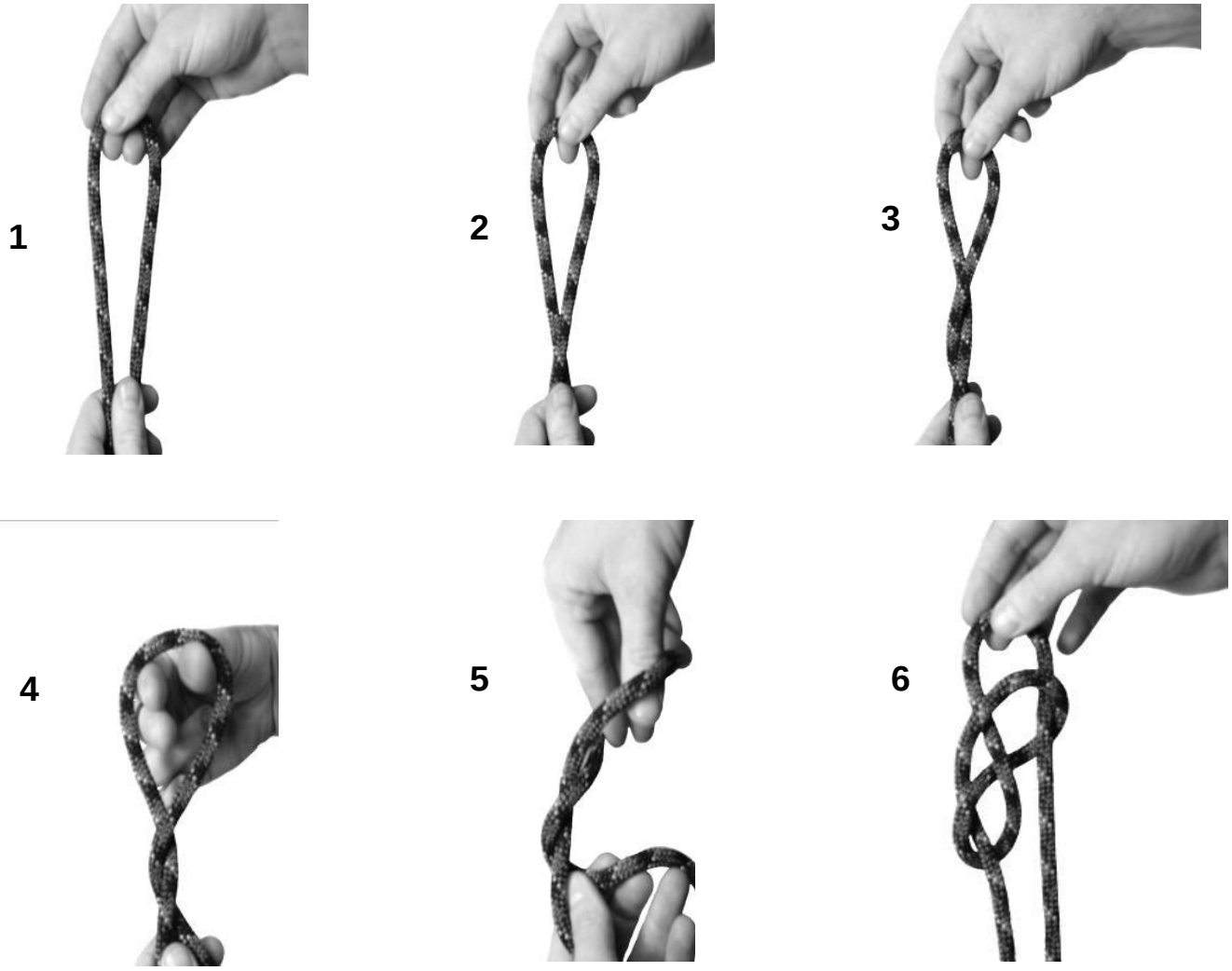


Figure 21
MOR Figure Eight Slip

Table of Contents

(12) MIDDLE OF THE ROPE PRUSIK.

(a) Purpose: To attach a moveable rope to a fixed rope.

(b) Tying the Knot:

- Place a bight of rope over the fixed rope. The closed end of the bight is 4 to 6 inches below the fixed rope. The running ends are closest to you.
- Reach down through the bight pulling both running ends through the bight and continue around the anchor, repeat 2 more times. You will now have three round turns on the fixed rope and a locking bar running across them.
- Dress the wraps and locking bar down to make sure they are tight and not twisted.

(c) Checkpoints:

- Three round turns with a perpendicular locking bar.

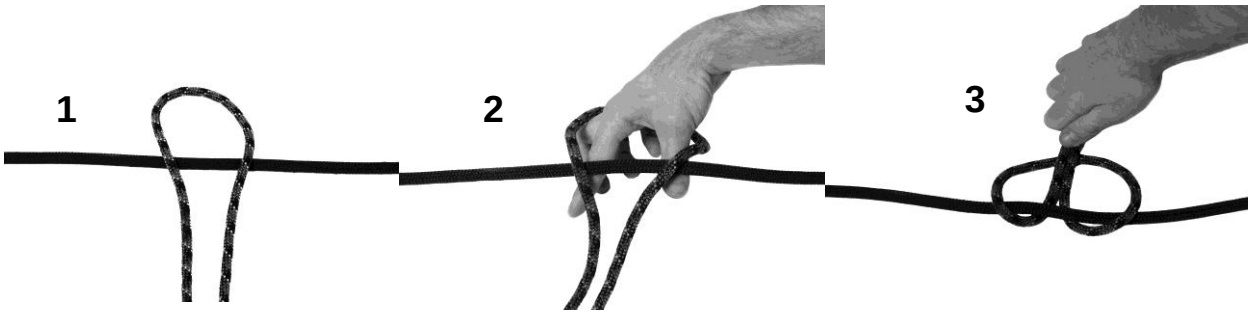


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Table of Contents

(13) END OF THE ROPE PRUSIK.

(a) Purpose: To attach a moveable rope to a fixed rope at the end of a rope.

(b) Tying the Knot:

- With the running end, make three turns around the fixed rope, working to your right and top to bottom.
- With the running end, come back over the standing part and under the fixed rope.
- Come over the fixed rope and make three turns working toward the right, bringing the running end under the locking bar.
- Dress the knot down and stabilize with a bowline.

(c) Checkpoints:

- Three round turns with a perpendicular locking bar.
- Stabilized with a bowline within six inches.
- Both ropes between the Prusik and bowline have equal tension.
- Minimum 4-inch pigtail.

Figure 30
EOR Prusik

Table of Contents

(14) REROUTED FIGURE OF EIGHT.

(a) Purpose: To tie the climbing rope around a fixed object or into a harness.

(b) Tying the Knot:

- Grasp the top of a 2-foot bight.
- With the other hand grasp, the running end (short end) and make a 360-degree turn around the standing end.
- Place the running end through the loop you have just formed.
- Place the running end around the anchor (or into the harness).
- Route the running end back through the figure eight tracing the original knot to the standing end.
- Remove all unnecessary twists and crossovers. Dress the knot down.

(c) Checkpoints:

- Two ropes running side by side in the shape of a figure eight.
- The knot will form a fixed loop around a fixed object or harness.
- Minimum 4-inch pigtail.

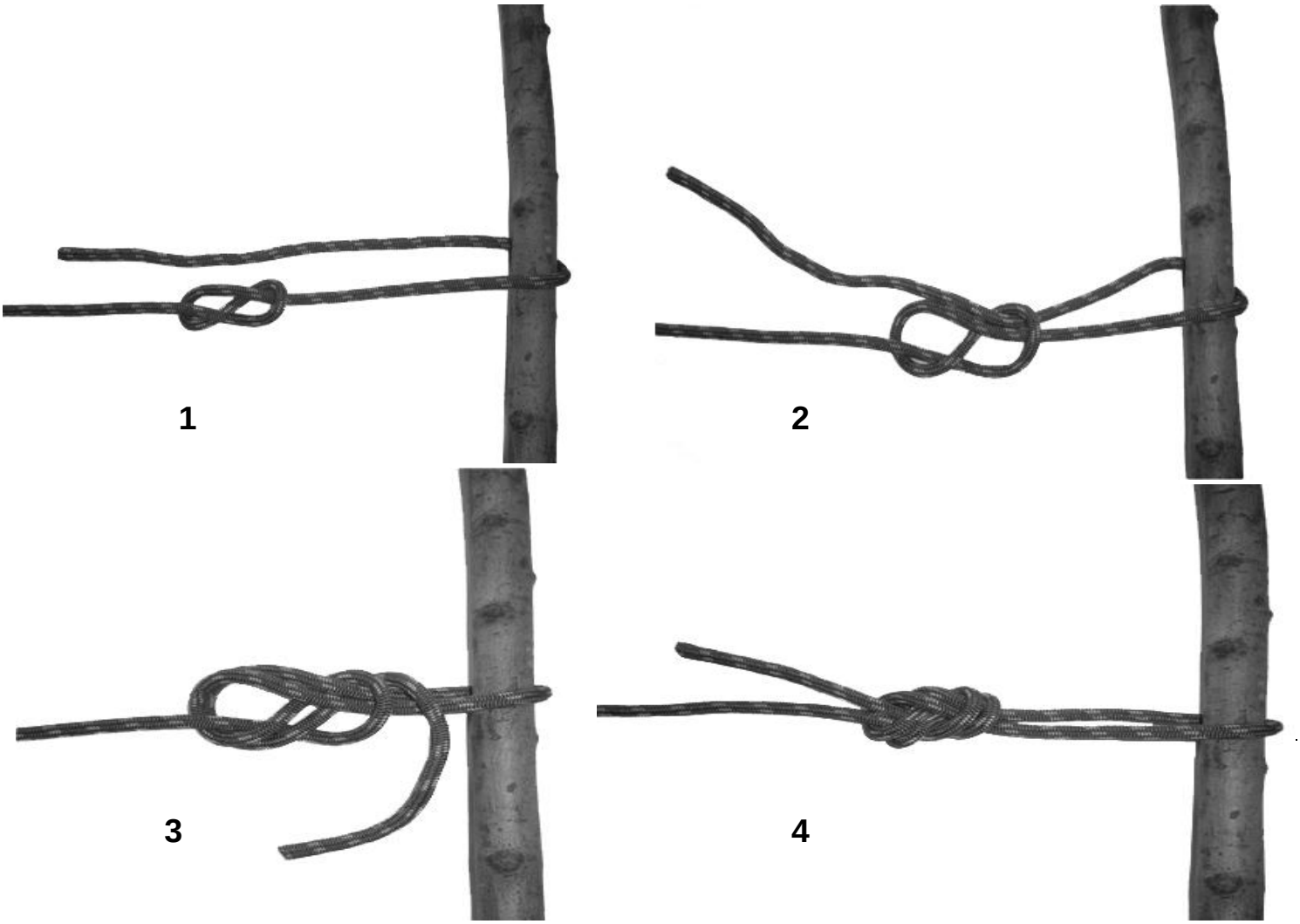

Table of Contents

(15) MUNTER HITCH.

(a) Purpose: To form a mechanical belay.

(b) Tying the Knot:

- Hold the rope in both hands, palms down about 12 inches apart.
- With the right hand, form a loop away from your body toward the left hand. Hold the loop with the left hand.
- With the right hand, place the rope that comes from the bottom of the loop over the top of the loop.
- Place the bight that you have formed around the rope into the pearabiner. Lock the pearabiner.

(c) Checkpoints:

- A bight passing through a locked carabiner.
- The closed end of the bight is around either the running or standing end.

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Table of Contents

(16) SUPER MUNTER HITCH.

(a) Purpose: To create a high friction mechanical belay.

(b) Tying the Knot:

- Tie a Munter hitch with the closed end of the bight on the standing end of the rope.
- Bring the running end of the rope under the standing end and form a bight around the standing end.
- Clip the running end of the bight into the pearabiner and lock.

(c) Checkpoints:

- Two bights passing through a locked pearabiner.
- The closed ends of both bights are on the standing end of the rope.

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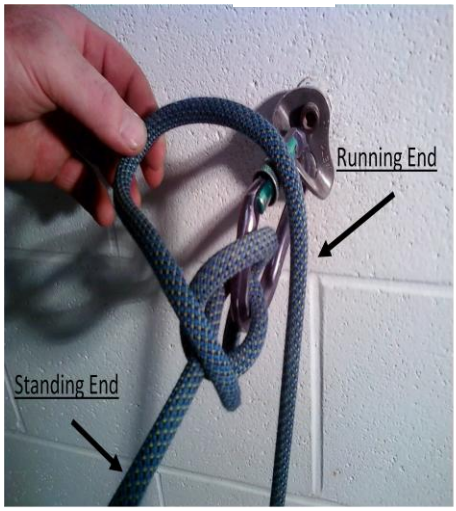

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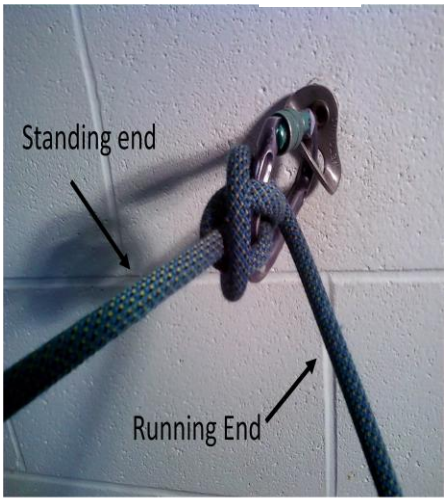


Table of Contents

(17) AUTO BLOCK.

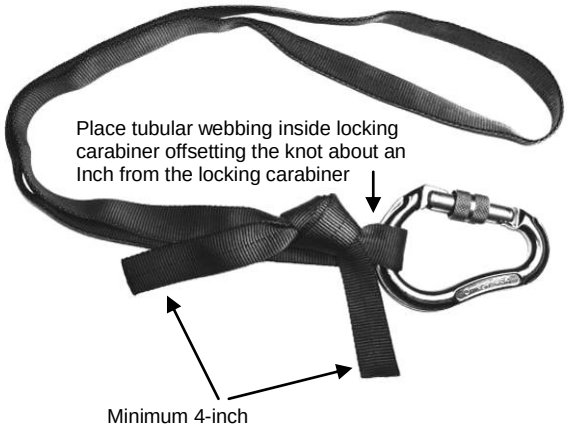
(a) Purpose: To attach a moveable piece of rope or webbing to a fixed rope that is easy to release under tension.

(b) Tying the Knot:

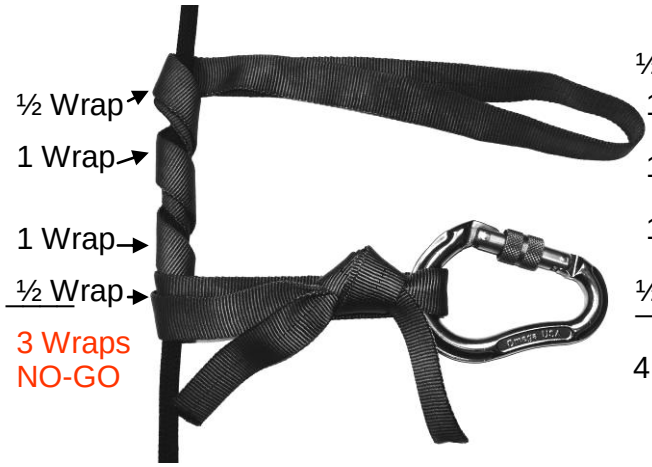
- Join a utility rope to form an endless loop, about 24 inches. You may use a standard length sewn runner or tubular webbing.
- Offset the joining knot. Wrap the clean portion of the endless loop around the rope a minimum of 4 times.
- Place both bights into a locking carabiner and lock.

(c) Checkpoints:

- Minimum of four turns around the rope.
- Both bights in a locked carabiner.
- The joining knot is offset and out of the turns.



Do Not Use Sewn Webbing
Made of spectra



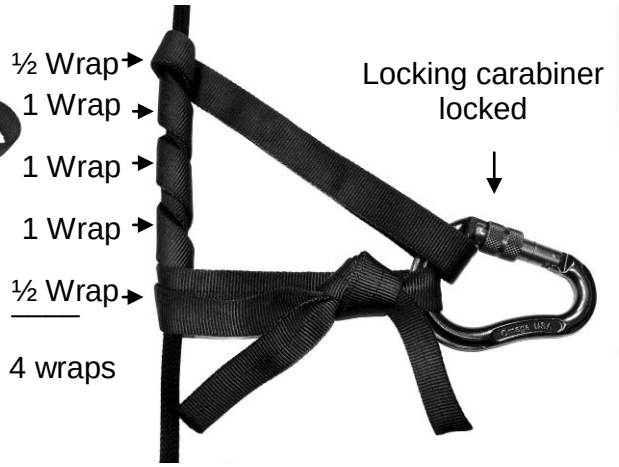


Table of Contents

(18) MUNTER MULE KNOT

(a) Purpose: To create a releasable anchor knot.

(b) Tying the Knot:

- Place a Munter hitch into a locking carabiner.
- With the brake strand(s) of the Munter, create an overhand loop and place onto the load strand(s) of the Munter hitch.
- Bring a bight through the overhand loop capturing the load strand(s) creating a slip knot.
- Dress the slip knot down against the Munter hitch.
- Tie an overhand knot around the load strand(s).
- Dress the knot down.

(c) Checkpoints:

- A bight passing through a locked carabiner.
- The closed end of the bight is around the load strand(s).
- Bight up through an over hand slipknot capturing the load strands.
- Overhand knot around the load strand(s) with a minimum of 4” pigtails.

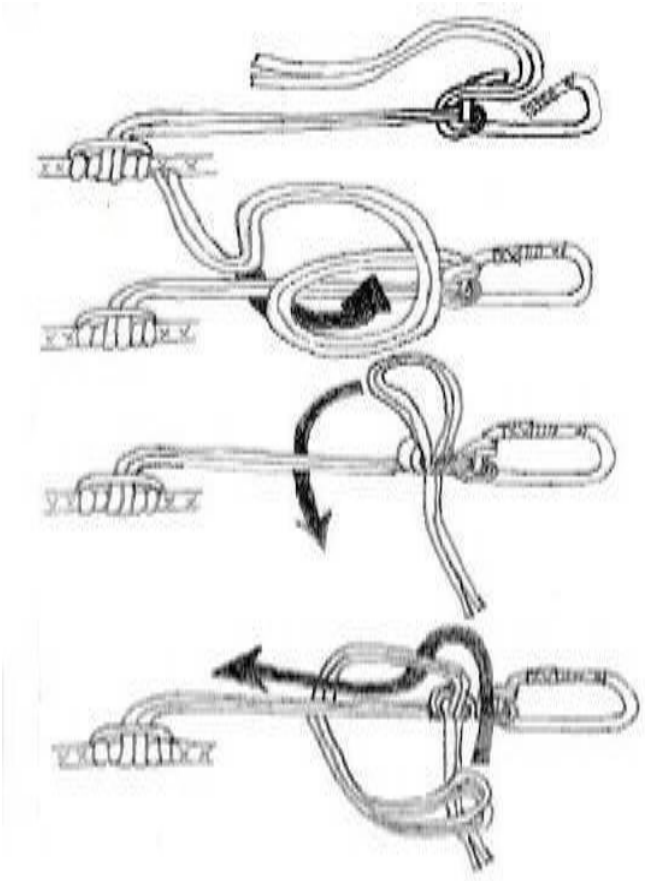


Table of Contents

(19) BUTTERFLY COIL WITH FARMER'S TIE OFF.

(a) Purpose: To prepare a climbing rope for carrying on the body.

(b) Tying the Knot:

- Backfeed the doubled rope until you have the approximate center bight.
- Place the center bight over your head and drape it in front, over your shoulder so it hangs no lower than your waist.
- With the rest of the doubled rope in front of you make doubled bights placing them over your head in the same manner as the first bite, ensuring you alternate from side to side (right to left, left to right etc.) while maintaining equal length bights.
- Continue coiling until you have approximately two arms lengths of rope left. Carefully remove the coils from your neck/shoulders holding the center in one hand.
- With the two ends, wrap the coils a minimum of three times ensuring the first wrap locks on itself.
- Pass a doubled bight from the two loose ends up through the apex of the coils, pull the two loose ends through the doubled bight and dress it down.
- Place the Butterfly Coil on your back.

(c) Farmer's Tie Off:

- Place the Butterfly Coil on your back.
- Separate the two loose ends.
- Bring one over your right shoulder and one over left shoulder.
- Continue down under your arms and across your back.
- Ensure the rope crosses over the coils.
- Secure the two ends in front with a square knot without overhand safeties.

(d) Checkpoints:

- Coils uniform and even, within 6 inches.
- A minimum of three turns around the coils, with the first one locking on itself.
- A double bight through the top of the coils, securing the standing ends.
- A minimum of one wrap around the body and the coils tied off with an unsafetied square knot.
- Minimum 4-inch pigtails.

Butterfly Coil Figure 37

Butterfly Coil with Farmer's Tie Off

Figure 38

Table of Contents

(20) FIELD EXPEDIENT SEAT HARNESS.

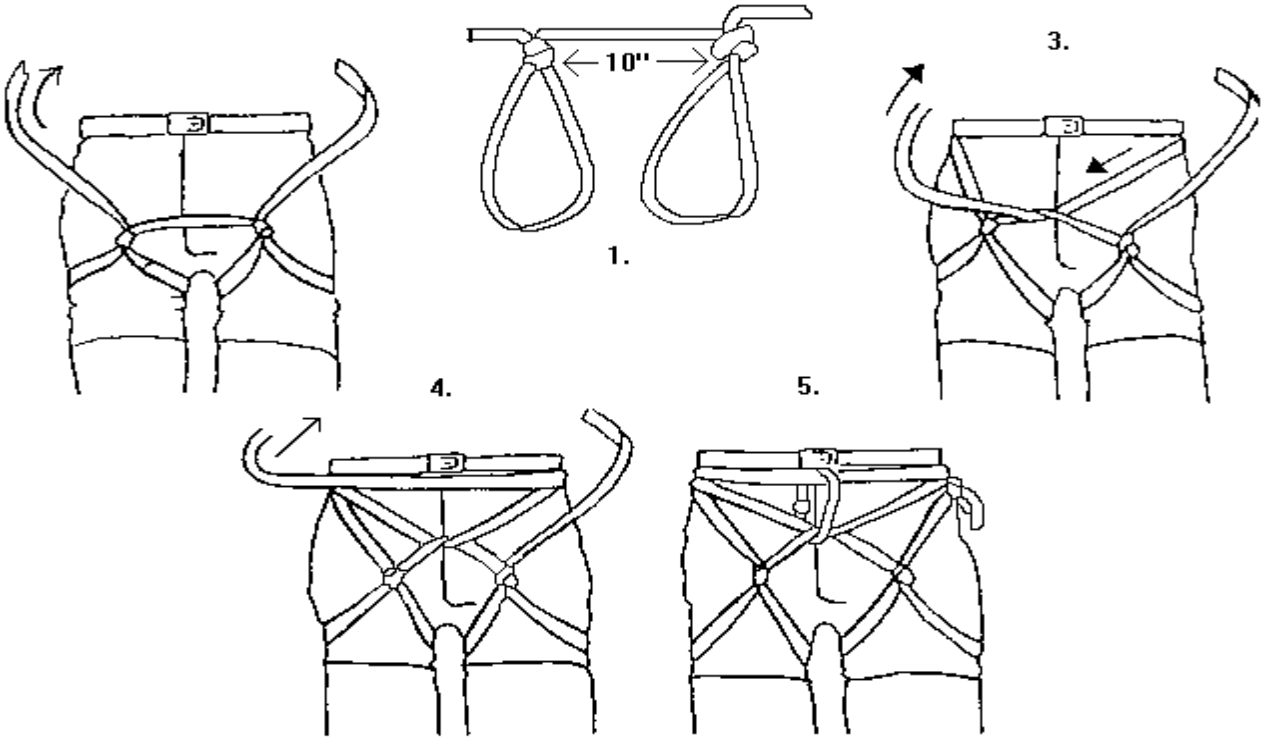
(a) Purpose: To form a seat harness out of tubular webbing for rappelling or climbing.

(b) Tying the Knot:

- Take a piece of tubular webbing 22 feet long.
- Leave about 24 inches of tail. Tie an overhand on a bight to form a fixed loop. Make this loop slightly larger than your left thigh.
- Move 10 inches on the webbing and tie a second loop. Tie an overhand on a bight to form another fixed loop. Make this loop slightly larger than your right thigh.
- Step into each loop and bring it up around your thighs, with the 24-inch tail on the non-brake hand side. The 10-inch piece is in front and the long portion on the brake hand side.
- Take the long end and run it around the back and just above the hipbone to the front.
- Run this end under and through the 10-inch section at the front and pull everything snug.
- Bring the end around the back again, to the guide hand side and tie it together with a water knot (If enough webbing is left over run the long end around the waist an additional time before tying off).

(c) Checkpoints:

- Two overhand knots on the front of the legs, 10 inches apart.
- Leg loops snug on the legs and above cargo pockets.
- A minimum of two turns around the body, snug and above the hips, the first wrap around the body running through the webbing between the overhand knots.
- Minimum 4-inch pigtail after the water knot.



You can use an expedient seat harness with or without a chest harness. Construct the harness from 22 feet of 1 or 2 inch tubular webbing. Inspect the webbing before and after each use. Use the field expedient seat harness when falls are very likely or you will be operating on steep terrain for long period.

Table of Contents

(21) RAPPEL SEAT.

(a) Purpose: To form a rope harness for rappelling.

(b) Tying the Knot:

- Find the middle of a sling rope, and make a bight.
- Decide which hand you will use as your brake hand and place the bight on the opposite hip.
- Reach around behind you and grab a single strand of rope. Bring it around to your front and tie two overhands on the other strand of rope, creating a loop around your waist.
- Pass the two ends between your legs, ensuring they do not cross.
- Pass the two ends up under the loop around your waist, bisecting your pocket flaps. Pull up on the ropes, tightening the seat.
- From rear to front, pass the two ends through the leg loops creating a half hitch on both hips.
- Bring the longer of the two ends across your front to your non-brake hand hip and secure the two ends with a safetied square knot.

(c) Checkpoints:

- Two overhands around the body, above the hips.
- Ropes not crossed between the legs.
- Half hitch on each hip.

Table of Contents

3 - Rope Management
071E9006

INTRODUCTION: A climbing rope is one of the most useful tools for a unit operating dismounted in the mountains. Soldiers must understand how to properly coil and carry the rope so it is easily accessible and ready to be deployed at a moment's notice. The quicker a unit can put a rope into use and negotiate a vertical danger area or establish a hauling system the more effective they will be at accomplishing their mission.

Identify the Procedures to Uncoil a Rope.

a. Uncoiling/Back-feeding/Stacking. When you need to use your rope, you must be able to uncoil and lay it on the ground properly to avoid kinks and snarls.
(1) After you have untied the Farmer's Tie-off, unfold the coils, drop the ends of the rope and lay the coil on the ground.
(2) After you have uncoiled the rope and it is lying on the ground, you should back feed the rope to minimize kinks and snarls.
b. Take one end of the rope in your left hand.
c. Run your right hand along the rope until both arms are outstretched.
d. Next, lay the end of the rope in your left hand on the ground.
e. With your left hand, re-grasp the rope next to your right hand and continue laying the rope on the ground.
f. The rope should be stacked in a neat manner on the ground.

Identify the Procedures to Throw a Rope.
a. To insure that the rope will not become kinked and snarled when thrown, it should be back stacked.
b. Tie off the bottom end of the back stacked rope to ensure that you do not lose the entire rope over the edge.
c. Single butterfly coil 10-12 coils.
d. A few preliminary swings will insure a smooth throw. The swings should be made with the arm nearly extended and the coil should be thrown out and up. When possible, the rope should be thrown so that the running end is thrown into the wind. In a strong crosswind, the direction of throw can be angled into the wind so that the rope will land on the desired target.
e. As soon as the rope starts to leave the hand, the thrower shouts the warning "Rope" to alert those below his position.

Note: Do not look up if you hear the command "rope" above you.

Identify the Procedures to Coil and Carry a Rope.
a. **Coiling the Rope.** Allow each loop to lie naturally, as you coil, rather than forcing it into a neat looking coil. This will reduce twists and kinks when you use it.
b. **Butterfly Coil.** This method is excellent for carrying a rope when you have to climb or carry the rope for a short distance. The Butterfly coil can be started from the middle (called a double butterfly) or from the end (single butterfly).
c. **Hand Method** (Double Butterfly).
(1) Back-feed the doubled rope until you have the center bight.
(2) With this bight in your left hand (the center of the rope) run your right hand along the rope until you have approximately one arm length of rope.
(3) Let go of the bight in your left hand and re-grasp next to your right hand, palm up. Run your right hand along the rope until both arms are outstretched.
(4) Bring your hands together, laying the rope in your left hand. Continue doing this, ensuring that the rope re-enters your hand from the same direction it exited.
(5) Continue coiling bights until you have approximately twelve to fifteen foot tails. Table of Contents

(6) Carefully remove the coils from your neck/shoulders holding the center in one hand.
(7) With the two ends, wrap the coils a minimum of three times ensuring the first wrap locks in it.
(8) Pass a double bight from the two loose ends up through the top of the coils, pull the two loose ends through the double bight and dress it down.
(9) Finish using the farmer's tie-off.

d. Buddy Team Method.
(1) Back feed the double ropes until you have the center bight.
(2) One team member stands with his feet shoulder width apart, arms down, waist bent, palms facing ground.
(3) The other member wraps the rope around the hands and neck of the first man.
(4) Continue coiling bights until you have approximately twelve to fifteen foot tails.
(5) The team member whose was coiling the coils around the first team member grabs the center of the coils, removes the coils off the first member's neck.
(6) With the two ends, wrap the coils a minimum of three times ensuring the first wrap locks on itself.
(7) Pass a double bight from the two loose ends up through the top of the coils, pull the two loose ends through the double bight and dress it down.
(8) Finish using the farmer's tie off.

e. Neck-Shoulder Method.
(1) Back feed the double ropes until you have the center bight.
(2) Place the center bight over your head and drape it in front, over your shoulder so it hangs no lower than your waist.
(3) With the rest of the double rope in front of you make double bights placing them over your head in the same manner as the first bight, ensuring you alternate from side to side (right to left, left to right etc.) while maintaining equal length bights.
(4) Continue coiling bights until you have approximately twelve to fifteen foot tails.
(5) Carefully remove the coils from your neck/shoulders holding the center in one hand.
(6) With the two ends, wrap the coils a minimum of three times ensuring the first wrap locks in it.
(7) Pass a double bight from the two loose ends up through the top of the coils, pull the two loose ends through the double bight and dress it down.
(8) Finish using the farmer's tie off.

f. Farmer's Tie Off.
(1) Place the Butterfly Coil on your back.
(2) Separate the two loose ends.
(3) Bring one over your right shoulder and one over left shoulder.
(4) Continue down under your arms and across your back.
(5) Ensure the rope crosses over the coils.
(6) Secure the two ends in front with a square knot without overhand safeties.

g. Coiling the 18-foot, 7mm Utility Cord.
(1) Bring the two ends of the rope together, ensuring there are no kinks in the rope.
(2) Place the ends of the rope in your left hand with the two ends facing toward you.
(3) Coil the doubled rope in a clockwise direction forming 6-8 inch coils, until an approximately 12-inch bight is left.
(4) Wrap that bight around the coil, ensuring that the first wrap locks on itself.
(5) Make 2-3 wraps.
(6) Feed the bight up through the bights formed at the top of the coil. Cinch down.
(7) Hang the bight on a carabineer IAW SOP.

Table of Contents

4 - Cold Weather Clothing
071E9029

INTRODUCTION: Quality well maintained cold weather clothing is what allows us to operate in extreme conditions the enemy cannot. Not only must Soldiers understand how to properly wear the cold weather clothing system, leaders must also understand the differences in individuals and allow some freedom of choice in clothing selection.

Identify the Principles of Cold Weather Clothing.

a. **Clothing Principles.**

(1) *Goals.* When dressing for a cold weather environment, the goals are the following:

(a) To be warm and dry.

(b) To have a system of layers that allow us to maintain heat or ventilate, based on temperature and level of activity.

(c) To stay warm and get dry quickly when our clothing gets wet.

(2) *Insulation.* Insulating materials resist the transmission of heat. Air pockets within the fibers or layers of clothing trap the air warmed by the body and hold it close to the skin. Insulating materials are the following:

(a) Cotton. Cotton readily absorbs water and has no insulating value when wet.

(b) Wool. Wool also absorbs water, but retains dead air space structure when wet.

(c) Nylon. Nylon pile does not absorb much water, dries quickly and weight-for-weight is warmer then wool.

(d) Synthetic. Non-cellular synthetic filaments such as polyesters and acrylics absorb very little water and dry quickly. Spun synthetic filaments (Dacron Hollofil II, Lamilite, Polarguard, Thinsulate) are lighter and unlike down, do not collapse when wet. They are an excellent alternative insulation in areas with a moist climate. Synthetics are heavier and less compressible than down. They also tend to hold odor.

(e) Down. Down has the best insulating value for its weight of all materials. It is also very compressible. You can squeeze a down garment into an incredibly small space and yet it will regain full loft. Never get down wet. Down does not loft when wet and offers little insulation. Drying a down garment in the field is very difficult.

(f) Silk. Silk is the most versatile, breathable, durable and comfortable fiber in the world. It is a natural insulator and possesses the unique ability to draw moisture away from the skin.

(3) *Layers.* Several thin layers provide more warmth then a single heavy layer. The windproof, water-repellent garment helps maintain the warm inner air. Adding or removing the layers allow the body to maintain heat or ventilate, based on temperature and activity.

(4) *Ventilation.* Perspiration fills the air spaces of the clothing with moisture. Once clothing becomes wet, it becomes a heat conductor. The body cools as moisture evaporates. Cold weather clothing combats these effects. Loosening or opening the neck, waist, hip, sleeve and ankle fastenings provide ventilation.

Safety Note: All petroleum-based fabrics melt easily when exposed to heat. These include nylon, polypropylene, capolene, Hollofil, Dacron, Polarguard, Thinsulate and others. Be careful around stoves and fires.

b. **Cold Weather Conditions.** Two types of weather conditions affect the use of cold weather clothing: wet and dry. Temperature and wind velocity amplify the conditions.

(1) *Cold-Wet Conditions.* Cold-wet conditions occur when temperatures alternate between freezing and thawing. Freezing and thawing creates mud and slush on the ground. Often rain and wet snow accompany these conditions. During these periods, Soldiers should wear clothing that consists of a water-repellent, wind

Table of Contents

resistant outer layer and inner layers with sufficient insulation to provide ample protection in moderately cold weather (above 14 degrees F). Waterproof footwear is essential.

(2) *Cold-Dry Conditions.* Cold dry conditions occur when the average temperature is below 14 degrees F. The ground is frozen and the snow is dry. Strong winds cause low temperatures to seem colder and increase the need for protection of the body from wind-chill. During these periods, Soldiers should have additional layers of insulation available. This is particularly true when doing sedentary tasks after periods of exertion.

c. **C-O-L-D-E-R Acronym**.

(1) *Clean.* Keep Clothing Clean. Clothes matted with dirt and grease lose their insulating property. Change clothing often. All outer garments of the cold weather clothing system are washable. Each item has laundry instruction labels.

(2) *Overheating*. Avoid Overheating. Overheating causes perspiration, which in turn causes clothing to become damp. Wear the minimum amount of clothing to avoid overheating. Heat production is an individual thing. Clothing requirements are different for each Soldier. Adjust clothing based on the air temperature and on the level of activity. Open or remove layers as necessary. It is better to be a little chilled than to be excessively warm. This is especially true before heavy activity.

(3) *Layers*. Wear Clothing Lose and in Layers. Tight clothing and footgear restricts circulation and promotes cold injuries. If the outer garments fit tightly, the layers underneath it will restrict circulation. Tight garments lessen the volume of trapped air and reduce the insulation.

(4) *Dry.* Keep Clothing Dry. Moisture will soak into clothing from the inside and the outside. Snow and frost that collect on the uniform may melt from the heat radiated by the body. Outer clothing is water repellent and will shed most of the water created from melting snow and frost. The surest way to keep dry is to prevent snow and frost from collecting. Before entering heated areas brush or shake snow off your uniform. Do not try to rub snow off as this works it into the fabric.

(5) *Examine*. Examine for Holes, Tears, and Broken Fasteners. Like any piece of equipment, you should inspect your clothing prior to use. Holes, rips or broken parts make your clothing perform less efficiently.

(6) *Repair or Replace.* Repair or Replace Damaged Clothing. Damaged clothing should be turned into prior to use so you are prepared to conduct your mission. Re-supply in the field is difficult and not always possible.

Identify the Methods of Heat Loss.

a. Conduction. Heat transfer from one solid object to another.
b. Convection. Heat transfer from one solid object to air (i.e. wind).
c. Radiation. Infrared energy given off by warm objects.
d. Evaporation. Heat transfer to water during liquid to gas exchange.
e. Respiration. Heat loss from exhale.

Identify the Components of the Gen I Cold Weather Clothing.

a. Description and Wear of Extended Cold-Weather Clothing System [ECWCS] Gen I [modified]. The ECWCS provides for extended field operations in the temperature range of + 40^0 F through - 60^0 F. Components use the most recent materials and technology. The result is a reduction in weight and bulk without loss of protection from the cold. The ECWCS uses the layer approach that draws moisture away from the body.

(1) *First Layer*. This layer consists of polypropylene underwear, worn next to the skin. This material draws moisture away from the skin, reducing conductive heat loss. Make sure there is no other layer between this layer and your skin. This could be a lightweight or a mid-weight layer.

(2) *Second Layer.* The second is both the synthetic fiber pile (SFP) shirt and trousers or the polyester batting field jacket and field pant liners. The SFP shirt and trousers dry quickly when wet and provide a high

Table of Contents

degree of insulation. Neither the SFP shirt and trousers nor the wool shirt or sweater should be worn as an exterior garment in wet or windy conditions. Wear the SFP trousers during periods of relative inactivity only. You should not wear them while snowshoeing or skiing.

(3) *Third Layer*. This layer consists of polyester batting field jacket liner and field trouser liner. Use the jacket for extra insulation only during periods of light activity. Use this liner as a separate jacket. Do not attach the liner to the parka. (The field trousers provide a durable, wind resistant, water-repellent layer to protect the insulating underpants and trouser liners).

(4) *Fourth Layer*. Windproof, waterproof parka and trousers make up this layer, which protects the inner layers. Care must be taken when wearing an outer shell garment because even a Gore-Tex shell has a limited vapor transfer rate that cannot keep up with sweat caused by high activity levels. Shells should only be worn when physical activities are low and protection is required from wind or rain/snow. The parka has underarm zippers to allow air to circulate during heavy activity.

(5) Fifth Layer. This layer consists of the standard camouflage overwhites.

Identify the Components of the Gen III Cold Weather Clothing System.

a. Description and Wear of Extended Cold-Weather Clothing System [ECWCS] Gen III. The 3rd Generation of the Army's Extended Cold Weather Clothing System (ECWCS) is a radical re-design of the cold weather clothing system for the U.S. Army. The GEN III ECWCS includes seven layers of cold weather protection. Field-testing of GEN III is complete and the Army is fielding complete systems (every layer) as a kit.

Level 1

a. **First Layer**. Undershirt. A lightweight crew neck undershirt and elastic waistband drawers constructed with Polartec® Powerdry® Silk weight material, which is highly breathable and has moisture wicking properties. Desert sand in color. Kit includes two (2) sets.

Level 2

a. **Second Layer**. Shirt. A mid-weight long sleeve shirt and elastic waistband drawers constructed with Polartec® Powerdry® Heavyweight material, which offers stretch to allow for increased comfort during movement, is highly breathable and has moisture wicking properties. Desert sand in color. Kit includes one (1) set.

Table of Contents

Level 3

a**. Third Layer**. Jacket Fleece A zipper jacket with raglan sleeves and chest pockets constructed with Polartec® Thermal Pro® material, which creates air pockets that trap air and retain body heat providing outstanding warmth without weight. This material also offers excellent breath ability and the ability to dry quickly. However, this layer is not recommended as an outer garment for use during inclement/windy weather. Foliage Green in color. Kit includes one (1) piece.

Level 4

a. **Fourth Layer**. Jacket Wind a nylon/spandex zippered jacket with angled chest pockets

(1) Offers wind protection and environmental comfort with low weight and bulk
(2) Angled chest pockets
(3) Velcro closure sleeve pockets
(4) Full-length zipper, Elasticized cuffs
(5) Identification Friend or Foe Tape
(6) Kit includes one (1) piece).

Level 5

a. **Fifth Layer**. Soft Shell Jacket and Trousers

(1) Jacket has center front opening with wind protection flap, collar with cover for an enclosed collapsible hood, raglan sleeves, and two front pockets.

(2) Trousers have a front fly opening with wind protection flap, two front pockets, belt loops, and provisions for suspenders.

(3) Constructed with Nextec® fabric
(4) Resists penetration by water
(5) Highly durable and breathable

Table of Contents

Level 6

a. **Sixth Layer.** Wet Weather Jacket and Trousers

(1) The jacket has a front zipper with zipper pass through front middle pockets. An adjustable hood, a visor, and a hide-away collar. Elastic wrist cuffs with a strap for adjustability.

(2) The trousers have a front fly opening, two pass through pockets with flaps for water protection, an elastic waistband, and belt loops. A zipper on each leg that goes approximately ¾ of the length of the leg with flap cover for water protection. Elastic leg cuffs with a strap for adjustability.

(3) Constructed with 2 Layer Gore-tex® fabric

(4) Waterproof and windproof

(5) Extremely breathable

(6) Sealed seams

Level 7

a. **Seventh Layer**. Extreme Cold Parka and Trousers

(1) The jacket has a front double zipper, which permits opening of the jacket from the top or bottom. The jacket has a draw-cord closing hood and bottom. The jacket has two vertical zippered outer pockets and two inner mesh pockets.

(2) The trousers have a 3-piece elastic webbing waistband with a front fly opening with 2-way zipper. Trouser has an elastic leg cuff with a full-length 2-way leg zipper.

(3) Three Layer Construction

(4) Fabricated with an outer layer, an insulation layer, and an inside layer of lightweight rip-stop material.

(5) Water Resistant

(6) Highly durable and breathable

(7) Urban Gray in color.

Table of Contents

Identify Cold Weather Handwear and its Proper Wear.

a. **Description.**

(1) *Liners/Inserts.* These thin gloves can be made of wool, cotton or polypropylene. They are the first layer used in your glove system.

(2) *Gloves.* Wear standard black leather gloves in mild weather. In colder weather, wear the same gloves with wool inserts. However, many commercial gloves provide more cold weather protection and greater versatility. In each case, Soldiers should utilize liners as the first layer in their glove system.

(3) *Mitten Shells, Cold Weather with Trigger Finger and Mitten Inserts*. These mittens provide greater warmth by reducing the surface area exposed to the cold and by keeping the fingers together. The elasticized, extended cuff overlaps the parkas lower sleeve to protect the wrist from snow and cold air.

(4) *Mittens, Arctic*. During periods of extreme cold, wear the arctic mitten set. The mitten has liner, a leather palm, a cheek warmer and a snap fastener on the back. The neck strap allows the mittens to be conveniently carried snapped together behind the back. Carry the arctic mitten set whenever there is a possibility of the onset of severe cold weather.

b. **Use of Handwear.**

(1) The outer shells should be worn with the minimum insulation necessary to provide protection, thus avoiding perspiration. You can interchange trigger finger inserts with either hand. Changing them to opposite hands frequently will ensure even wear.

(2) When handling cold metals, cover your hands to protect against frostbite. Always have a thin contact glove to wear when doing tasks that require dexterity in cold weather.

(3) To keep hands warm when wearing mittens, curl your fingers (inside the mittens) against the palm of the hand, thumb underneath the fingers or flexed inside the mitten whenever possible to increase blood circulation. Stimulate circulation by swinging the arms in vertical circles. Carry an extra pair of inserts.

c. Equipment Security Cords. When wearing gloves or mittens it often becomes difficult to operate zippers. It is helpful to attach a short section of 550 cord to zipper tabs for cold weather use. If mittens or gloves do not already have an attachment system, tie 550 cord to them and attach the cord to the Velcro wrist closures on the Gore-Tex jacket.

Identify Cold Weather Footwear and its Proper Wear.

a. **Footwear.**

(1) *General Principles.*

(a) Feet. Feet are more vulnerable to cold then are other part of the body. They get wet easily, from external moisture sources and perspiration. Restricted circulation is often a problem. Footwear gets wet more often than any other item of equipment. Always carry a change of dry socks. At every opportunity dry your feet and change your socks. Wipe out the inside of your boots to get them as dry as possible. Exercise and massage your feet when changing socks.

(b) Socks. Socks carry out four vital functions: cushioning, insulation, absorption of perspiration and reduction of foot-to-boot friction. The toes must always be free to wiggle. Three tightly packed pairs of socks give less protection from the cold than two looser layers. The compression of fiber reduces the dead air space that is the chief source of insulation. AVOID LACING FOOTWEAR TOO TIGHTLY.

(c) Types of Socks.

- Polypropylene. Use as a base layer to transport moisture away from the feet.
- Insulating. Use to provide warmth. Could be wool or synthetic.
- Vapor Barrier Socks. Vapor Barrier socks (VB socks) keep your feet warm by using heat lost through perspiration. They are constructed from Ripstop coated nylon with factory-sealed seams and have a draw cord with cord lock at the cuff. They can be worn between a liner sock and your insulation sock. This keeps your insulating heating sock from getting wet from perspiration. Another option is to wear the VB sock between your insulating sock and your boot. Although this will require changing of your insulating sock, it is less likely to produce blisters and an insulating sock should maintain some insulating value when wet. Dry the vapor barrier socks by turning them

inside out and letting them air dry. Carry additional polypropylene socks or insulating socks and change them as time permits. Improvised vapor barrier may be fashioned from plastic bags.

Safety Note: Air out your feet whenever possible. Prolonged wear of the vapor barrier sock without proper foot care could lead to immersion foot.

(2) *Types of Boots.*

(a) Intermediate Cold/Wet Boot (ICWB). The ICWB is to be worn in mean temperatures ranging between 14 – 68 degree F. A Gore Tex liner has been designed to protect your feet from wet environments and cold injuries. This boot should not be used in sustained cold weather operations and must not be fitted to tight.

(b) Plastic Mountaineering Boots. There are many brands of plastic mountaineering boots currently in use by the military, each with its own specifications, advantages and disadvantages. They can be best described as a "flexible ski boot". They allow the Soldier mobility with many different types of equipment, including snowshoes, skis and crampons. They are flexible enough to walk for extended periods, yet rigid enough to provide support for skiing and ice climbing. They provide much more warmth than all other military boots except the Vapor Barrier Boot. Most of the boot is waterproof.

- Inner Boot. These boots have a soft, flexible inner boot. The hard shell outer boot has a hinge at the ankle for flex when walking. Both the inner and outer boots have lace-up tightening systems. This system allows the Soldier to fit the boots properly. Remove the inner boots each night and air dry. Use a dry cloth to wipe off the inside of the outer boot and the outside of the inner boot. Avoid getting the boots close to a heat source. Contact with liquid petroleum products will cause damage.
- In the field, after wiping dry, hang the inner boot from the tent drying lines or place in your sleeping bag. Place the outer boot between the sleeping bag and the pad to keep warm.
- The range of protection provided by the plastic boot depends on the manufacturer, activity level and gaiter system used. The addition of super-gaiters or over boots dramatically increases the efficiency of the boots.
- Adjustment. Adjust boots by tightening or loosening the laces, on the shell, the liner or both if laces are present. The fit should be snug but not so tight to cut off circulation to the foot.

(c) Leather Mountaineering Boot.

- Construction. Leather Mountaineering Boots have either a 3/4-length shank (semi-rigid) or a full shank (rigid). Shanks, once made from steel, could bend or break over a long period of use. Now, very few shanks are made of steel. Most are now carbon fiber or fiberglass and are much less prone to snapping or bending. Leather offers greater comfort and allows a wider range of movement and flexibility. They must be regularly waterproofed and never allowed to dry out completely as cracking can occur. If you are on a mission with no method to dry the boots out, there is a risk of foot injuries.
- Crampon Compatibility. You cannot fit all types of crampons to leather boots. Only leather boots with a toe groove and heel lug will take a **step-in** crampon. **Strap-on** crampons on leather boots should not be tightened up to the same degree as they might be on plastic because you might restrict the circulation of blood to your feet. Single leather boots are not going to be suitable for high altitude climbing or if extremely low temperatures are to be encountered. They can be made warmer by inserting a thermal insole into the boot and/or by wearing an insulated super-gaiter over the top.

(3) *Maintenance of Boots*.

(a) Treat leather boots with a non-petroleum product. Petroleum-based products tend to break down the leather and stitching.

(b) You can usually repair VB boots with tire patching material. When regular patching material is not available use duct tape to prevent moisture from reaching the insulation in the boot. Turn in the boot for replacement at the earliest possible time. Wash the inside of the boots at least once a month with a

mild solution of soap and water. Do not clean the boots with an abrasive cleanser. Do not apply polish or paint to any part of the boot, as it will cause the rubber to deteriorate.
(c) The plastic boots differ only slightly and the inspection and care are the same. Check the outer shell for cracks and cuts. Insure that there is no separation between the sole and the boot shell. Insure that the flexible gusset and the neoprene seal at the bottom are intact. Inspect the inner boot for tears and splits. Finally insure that both inner and outer boots have serviceable eyelets, hooks and laces.
(d) Storage. Boots should be cleaned with a cloth utilizing mild soap and water and thoroughly dried; do not immerse the inner boot. Wipe the gusset and outer boot with a plastic preservative such as Armor-All. Loosely lace them to maintain the shape of the molded plastic. Store boots in a cool dry place away from direct sunlight.

b. **Gaiters.** Gaiters are used to prevent snow, ice, mud, twigs and stones from entering your footwear. The use of waterproof fabrics or other breathable materials laminated to the nylon makes the gaiter an integral component of the cold weather clothing system. Gaiters are available in three styles.

(1) *Nylon Shell*. The most common is a nylon shell that may or may not have a breathable material laminated to it. The open front allows the boot to slip easily into it and is closed with a combination of zipper, hook-pile tape and snaps. It will have an adjustable neoprene strap that goes under the boot to keep it snug to the boot. The length should reach to just below the knee and will be kept snug with a drawstring and cord lock.

(2) *Full Gaiter*. This gaiter completely covers the boot down to the welt. It can be laminated with a breathable material and can be insulated if necessary.

(3) *Overboot*. The overboot is specific to high-altitude mountaineering or extremely cold temperatures. It is worn completely over the boot and must be worn with crampons because it has no traction sole.

Identify Methods of Protecting the Face and Head.

a. **Face Protection.**

(1) *Cold Weather Mask*. Wear the cold weather mask during severe wind-chill conditions. Remove the mask regularly to check for frostbite.

(2) *Wool Scarf*. Covering as much of your face as possible with a wool scarf will give some protection. Frost will cover the area over the mouth and nose. Keep the wet area outside the parka. Like the mask, remove the scarf regularly to check for frostbite.

(3) *Balaclava.* Wear the balaclava alone as a hat, under the ACH as a liner.

(4) *Goggles.* Goggles will also provide protection from the wind and blowing snow.

(5) *Neck Gaiter*. This item is a tube of material that fits around the neck and can reach up over the ears and nose.

b. **Headgear**. Heat loss through an uncovered head is extremely rapid, due to the excellent blood supply to the brain. There are several varieties of headgear:

(1) *Advanced Combat Helmet, ACH*. The ACH frequently is the designated outer layer of headgear. An additional layer may be necessary. For better protection against the elements, wear the hood under the ACH. If the tactical situation requires full peripheral, vision and maximum hearing neither of theses options are acceptable.

(2) *Cap, Patrol* . Use the patrol cap for milder temperatures in Wet-Cold conditions as a ACH liner.

(3) *Cap, Cold Weather Insulating, Helmet Liner* (Pile Cap). Use the liner to protect your lower face by bringing down and closing the Velcro flaps. You can wear the helmet liner as a separate hat if the tactical situation permits.

(4) *Cap, Wool, Black*. The issued black watch cap is warm but can be bulky and difficult to fit under a helmet.

(5) *Cap Fleece, Black or Olive.* The Gen III cap is lighter than the Wool Cap has better wicking capabilities and fits well under a helmet.

(6) Hood, Combat Vehicle Crewman Coverall, Balaclava. The balaclava protects against extreme cold and is well suited for stationary activities in Dry-Cold or Wet-Cold conditions.

Table of Contents

Identify Winter Camouflage Clothing and its Proper Wear.

a. **Camouflage Clothing.** The use of camouflage clothing is METT-TC dependent. The articles worn will vary from mission to mission and may vary during the mission.

(1) White winter camouflage clothing (over whites) consists of trousers, parka with hood, mitten shells and rucksack cover.

(2) Use of the white camouflage clothing is dependent on the background, vegetation and the amount of snow on the ground. Wear the complete white suit only when the terrain is completely snow covered. Use mixed clothing, white parka and dark trousers, or vice versa for mottled backgrounds.

(3) Soiled camouflage clothing loses its effectiveness. Exercise care when handling stoves, digging in dirt, cleaning weapons and other "dirty" tasks. Avoid scorching or burning the garments. Change or wash your clothing frequently. Overwhites should fit over the winter garments without causing any restriction of movement.

Identify Leader's Responsibilities for Clothing Selection.

a. **Leader's Responsibilities**.

(1) Many factors will influence the leader’s decision to the clothing and equipment his Soldiers should wear or carry. These include the weather, mission, and general physical condition of personnel and degree of group proficiency. Under normal winter conditions, sixty-five to seventy pounds are the maximum weight a man can carry and still be effective upon reaching his destination.

(2) Leaders should give particular attention to the additional organizational equipment required for a given operation. The individual Soldier’s combat load in cold weather operations exceeds that of a temperate climate load by more than twenty pounds.

(3) The leader must ensure that Soldiers operating in a cold weather environment know how to dress appropriately for their activity level and use that knowledge.

Note: Commanders must not be arbitrary in delineating strict uniform requirements because of the differences in individual metabolism. Allow some choice of inner and outer layers.

Table of Contents

Notes:

5 - Environmental Injuries

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INTRODUCTION: History and current actions have consistently demonstrated that despite technological advancements in Soldier clothing and equipment, the risk for environmental injuries remains high. The ability of Soldiers to perform and thrive in a hostile environment requires training and a detailed understanding of both environmental threats and methods of coping with them.

Identify Risk Factors.

a. **Risk Factors.**

(1) *Previous Injury*. Individuals who have suffered from previous injuries usually have an increased sensitivity and are prone to the injury happening again.

(2) *Fatigue.* Physical and mental weariness both contribute to neglect of vital tasks.

(3) *Discipline, Training and Experience*. Injuries are entirely preventable in a training environment. Reinforcement of these principles is essential to reduce the incidence of weather related injuries in combat.

(4) *Psychological Factors*. Injuries tend to occur in passive, negative and hypochondriac Soldiers. Such people are less active in situations in which activity is unrestricted and are careless about precautionary measures.

(5) *Geographic Orientation*. Soldiers with dark skin color and non-acclimatized personnel are more prone to cold weather injuries than less pigmented and local personnel are.

(6) *Drugs and Medication*. Any drug modifying judgment or the circulatory system can have disastrous effects on individual performance and survival in the cold.

(7) *Other Injuries.* Other injuries associated with reduction of blood flow increase the risk of cold weather injuries.

Identify cold weather injuries.

Prevent and Treat Dehydration.

a. **Definition**. Dehydration is the loss of water by the body.

b. **Cause.**

(1) You lose 1.5 to 2 quarts a day through sweating, breathing and urinating.

(2) Cold weather or altitude increases the loss to 4 or more quarts a day because of low humidity and cold diuresis.

(3) Diuretics increase urine output and contribute to dehydration.

(4) Diuretics are found in alcohol, chocolate, caffeine soda, tea and coffee.

c. **Signs and Symptoms.**

(1) Orange "snow flowers" from urination, dry mouth, tongue and throat, difficulty swallowing, tiredness, weakness, nausea, fainting, dizziness, vomiting, muscle cramping or difficulty focusing eyes.

(2) Constriction of the peripheral blood vessels (so the remaining blood goes to more vital organs) increases the probability of frostbite.

(3) Severe shock may develop following even minor injuries.

(4) Clots may form in the legs and can result in pulmonary embolism.

d. **Treatment**.

(1) Administer fluids orally for mild dehydration and with an I.V. for more serious cases.

(2) Keep the patient warm, but avoid overheating.

(3) Loosen clothes sufficiently to allow proper circulation.

(4) Allow plenty of rest.

(5) Have trained medical personnel treat and monitor.

Table of Contents

e. **Prevention.**

(1) Make a conscious effort to drink more when it is cold (by the time you are thirsty, you are already dehydrated).

(2) Drink a minimum of two quarts of water a day. Three or four quarts are necessary with increased exertion or higher altitude.

(3) Eating snow or ice does not provide enough water and it drains additional body heat.

(4) Light yellow urine is a good indicator of proper hydration. If using diuretics, compensate with extra water.

Prevent and Treat Constipation.

a. **Definition.** Constipation refers to the passage of hard, dry stools, not to frequency of bowel movements.

b. **Cause.** Reduced water intake and eating dehydrated foods, the disruptions of normal schedules and infrequent stops.

c. **Signs and Symptoms.**

(1) *Fecal Impaction*. The normal bowel reflexes become insensitive and allow a bulky, hard impacted mass.

(2) *Anal Fissure*. The passage of a hard, bulky stool causes a small tear (fissure) in the anus. Subsequent bowel movements are painful and may have a small amount of bleeding.

d. **Treatment.** Fluid and a high-fiber diet are normally sufficient. Laxatives are usually not necessary.

(1*) Fecal Impaction*. There is no alternative to manually breaking and extracting a fecal impaction. Enema fluids will not enter the solidified fecal mass; laxatives do not affect the dilated rectal wall. Insert a finger (preferably gloved and lubricated) into the rectum. Break up the mass and gently remove. Give an enema after removal of the impaction.

(2) *Anal Fissure*. A low-fiber diet (milk, soups, and carbohydrates) for a few days often allows healing.

e. **Prevention.**

(1) Fluid and dietary fiber.

(2) Do not resist the urge to defecate. Even when you are tent-bound in foul weather, answer nature's call.

Prevent and Treat Frostbite.

a. **Definition.** Frostbite is frozen tissue.

b. **Cause.** Exposure to extreme cold temperatures.

c. **Signs and Symptoms.**

(1) Most commonly affected are hands, feet, ears and face. There is sudden blanching (whitening), followed by a momentary "tingling" sensation, then lack of pain and feeling in the affected area. White skin looks pale and waxy, dark-skin, dull and grayish. Tissue feels hard and cold to the touch.

(2) Upon thawing, living tissue is very painful; dead tissue is not. Blisters can appear up to 36 hours later. Blisters with clear fluid suggest live underlying tissue; bloody fluid suggests dead underlying tissue. With the most severe frostbite, damage restricts the circulation that the tissue does not blister and commonly is a deep purple color. Dead tissue separates spontaneously within weeks or months. Complete separation of larger extremities may require surgery.

d. **Treatment.**

(1) A hospital is the best place for rapid rewarming in a large water bath with the temperature precisely controlled between 110 F and 115 degrees F. Avoid rewarming in a wilderness environment, which results in more tissue loss.

(2) Loosen constricting clothing and remove jewelry. Do not attempt to thaw. Insulate and protect frozen tissue from cold or trauma. Evacuate to a hospital. If a patient must walk with frostbitten feet, it is better to walk on frozen feet (walking on thawed feet will increase the trauma). Never allow thawed tissue to refreeze. The damage will be worse than before.

Table of Contents

(3) Do not massage, rub with snow or apply cold-water soaks. Do not rewarm by exposing to open flame or other dry heat. Do not allow alcohol or tobacco. Alcohol increases loss of body heat and tobacco causes constriction of blood vessels in the extremities.

e. **Prevention.**

(1) You can prevent frostbite. In extreme circumstances, such as those surrounding an accident, emergency bivouac or unexpected storm, it may be difficult to avoid. There is no reason to get frostbite in a training environment.

(2) Keep socks and boots dry. Avoid tight fitting clothing, especially boots. "If your feet are cold, put on a hat."

(3) Use the buddy system to check ears and noses.

(4) Be careful when handling gasoline ("frostbite in a can").

(5) Think before touching metal (i.e. zippers) with bare skin.

(6) Smoking constricts blood vessels.

(7) If your skin goes numb, rewarm immediately! Rewarm your face with your hands. Rewarm your hands in your armpits.

(8) Rewarm feet by wiggling your toes, walking or running. If necessary, place them skin-to-skin against a buddy's abdomen.

f. **Miscellaneous .**

(1) The extent of damage varies with ambient temperature, length of exposure, moisture, clothing, activity, etc.

(2) Frostbite is divided into two categories, superficial and deep. Only the skin is frozen with superficial frostbite. Deep frostbite involves deeper tissues. Estimating the depth is notoriously difficult.

(3) Only time will reveal the extent of damage.

Prevent and Treat Immersion Foot.

a. **Definition.** Damage to the entire foot due to continued exposure to water or to moisture.

b. **Causes.** Immersion Foot (Trench foot) Immersion foot results from exposure to cold water for prolonged periods.

c. **Signs and Symptoms.**

(1) Minimal: red skin, variable sensory changes (numbness, tingling and pain).

(2) Mild: swelling, reversible sensory changes.

(3) Moderate: swelling, redness, blisters, mottling, irreversible nerve damage.

(4) Severe: tissue death.

d. **Treatment.**

(1) Dry and elevate feet.

(2) Do not massage feet.

(3) Avoid walking.

(4) Protect from further damage.

(5) Evacuate to a medical facility.

e. **Prevention.**

(1) Avoid prolonged immersion in cold water.

(2) When using foot powder, do not let it become caked. Rub off excess powder.

(3) Change to dry socks as frequently as required.

f. **Miscellaneous**

(1) Immersion foot is more of a problem for military personnel than for civilians.

(2) In the Falkland Islands, 14 percent of the hospitalized British battle casualties suffered immersion injuries (this reflects only the most severe cases).

(3) The colder the water, the sooner the injury.

(4) Cold wet socks and boots alone can make you a casualty. The cold induces intense vasoconstriction, depriving the feet of an adequate blood supply.

Table of Contents

(5) The injury may occur after a few hours or several days.

(6) After a period of days or weeks, permanent damage results, particularly to the nerves. The resulting injury may be so painful that it requires amputation.

(7) Sensitivity to cold is usually life long.

(8) It can occur in a hot or cold climate in a situation in which it is not possible to maintain proper foot hygiene.

Note: An antiperspirant with aluminum chlorohydrate may help.

Prevent and Treat Carbon Monoxide Poisoning.

a. **Definition.** Carbon Monoxide is a deadly, odorless gas that results from combustion.

b. **Cause.** Carbon monoxide binds to hemoglobin (the oxygen-carrying compound in blood cells) 200 times greater than oxygen.

c. **Signs and Symptoms.**

(1) *Mild.* Headache, dizziness, yawning, weariness, nausea, ringing in the ears and heart flutters.

(2) *Severe*. Bright red fingernail beds and cheek lining, sudden collapse, inability to walk or crawl, unconsciousness and death.

d. **Treatment.**

(1) Move the victim into fresh air at once. Synchronize rescue breathing with the gasps of the victim. Perform CPR as necessary.

(2) Keep the victim warm (i.e. sleeping bag). Exposure to cold might cause collapse.

(3) Never exercise a carbon monoxide victim. Exercise will increase the victim's oxygen demand.

(4) Transport the victim to a medical facility when possible.

(5) Oxygen in a hyperbaric chamber is the preferred treatment.

(6) Cerebral edema may be a complication.

e. **Prevention.**

(1) A steady supply of fresh air in living and working quarters is vital.

(2) Properly ventilate any source of combustion.

(3) Using a stove, fire, gasoline heater or internal combustion engine indoors can be fatal.

Prevent and Treat Hypothermia.

a. **Definition.** Hypothermia is a lowering of the body's core temperature.

b. **Cause.**

(1) *Heat Loss*. Heat is lost to the environment by four means: conduction, convection, radiation and evaporation.

(a) Conduction. Heat is lost by touching objects such as cold metal, sitting on ice, snow or cold rock. Wet clothing speeds the heat loss. Wet clothing can conduct as much as 240 times the heat from your body as dry clothing. Wet clothing acts much as a wick and if exposed to the wind will drain away heat much faster than the Soldier can generate it.

(b) Convection. Heat is lost through air or water movement. Wind-chill is a convection effect upon exposed skin. Wind-chill is the “real feel”, not the actual temperature.

(c) Radiation. Heat is transferred via infrared radiation. Radiation accounts for about 65% of total body heat loss. 85% of that loss is from the head and neck.

(d) Evaporation. The conversion of water from liquid to gas. Evaporation accounts for 20 - 30% of heat loss. Two-thirds of the evaporation occurs on the skin and one-third from the respiratory tract.

(2) *Heat Production*. Humans are tropical animals built to get rid of heat, not keep it. Without clothing, shelter, and fire, we cannot survive at temperatures below 82^{o}F. Most heat-producing metabolisms take place within the muscles and the liver. You can increase your body temperature by exercise, but it will not compensate for severe heat loss (i.e. cold-water immersion). Table of Contents

c. **Signs and Symptoms**. Hypothermia has no absolute diagnostic sign or symptom except a measured low body temperature. Other conditions may mask or mimic hypothermia. The following core temperature range is only a rough guide:

(1) *Mild Hypothermia*

(a) 98 to 95^{O}F - Chills, shivering, loss of fine finger movement (winding a watch, tying knots), lagging behind, stumbling over rough ground, withdrawn, denial.

(b) 95 to 93^{O}F - Appears capable but uncooperative, errors in judgment, confusion, difficulty using hands, slow stumbling pace, mild apathy and weakness.

(c) 93 to 90^{O}F - Frequent stumbling and falling, inability to use hands, slow thought and speech, not fighting cold, retrograde amnesia.

(2) *Severe Hypothermia*

(a) 90 to 86^{O}F - Shivering stops, slurred speech, staggering gait, vital signs below normal, incoherence, confusion, irrationality (i.e. paradoxical undressing), blindness, coma.

(b) 86 to 82^{O}F - Severe muscular rigidity, semi-consciousness, dilation of pupils, unapparent heartbeat or respiration.

(c) Below 82^{O}F - Unconsciousness, death due to ventricular fibrillation.

d. **Treatment**. Mild and severe hypothermia are approached as two entirely different problems.

(1) *Mild Hypothermia.* Decrease heat loss (insulate from ground, protect from wind, remove wet clothing, cover head and neck, move to warm environment, heat packs at neck, armpits, groin and belly).

(a) Increase heat production: exercise, warm sweet liquids and food, fire, hot bath or shower.

(b) Do not give alcohol.

(2) *Severe Hypothermia*.

(a) If conscious, do NOT let the victim exert himself. Exertion can kill due to ventricular fibrillation (v-fib). TREAT VERY GENTLY (a slight bump can cause v-fib).

(b) If unconscious, assess pulse and respiration for one to two minutes.

(c) If no pulse and respiration, start CPR.

(d) Severe hypothermia victims have been successfully resuscitated without brain damage after one and one-half hours of CPR.

(e) If transfer to a medical facility is possible within 6 hours, do not attempt to re-warm. The victim is often in a "metabolic icebox." Do hypothermia wrap and evacuate. Even in a hospital, the mortality rate is up to 80%.

(f) If transfer is not possible within 6 hours, slowly re-warm ONLY the trunk via skin-to-skin contact with another person in a sleeping bag. Do not immerse in a warm water bath, which can cause re-warming shock.

Note: Hypothermia Wrap-Outer layer: plastic/vapor barrier, Inner Layer: sleeping bag with heat packs next to armpit, neck and groin.

Note: "No hypothermia victim is cold and dead; only warm and dead."

e. **Prevention.**

(1) *Body Mechanisms.* Exposed to cold, blood vessels in the skin constrict. This shunts warm blood to the heart and brain (so that they can survive) but allows the body's periphery to cool.

(2) *Behavior.* A human's greatest protection against the cold is intelligent behavior. Hypothermia is called the "killer of the unprepared." Most wilderness cases of hypothermia occur in the summer. Preventing hypothermia simply requires enough water, food, clothing and shelter to spend the night.

(3) *Water.* Failure to replace lost water results in dehydration. Dehydration is found in all hypothermia cases.

(4) *Food.* Eat small amounts throughout the day to maintain a steady energy supply.

(5) *Clothing.* Layers should be dry, protect from the weather and allow adjustments.

Note: Plan for the worst possible conditions and know how to build emergency shelters. Table of Contents

Identify Solar Injuries.

Prevent and Treat Sunburn.

a. **Definition.** Sunburn is a thermal burn on the outer layers of skin caused by exposure to ultraviolet radiation from the sun.

b. **Causes.** Exposure to ultraviolet radiation.

c. **Signs and Symptoms.**

(1) *Mild* exposure produces redness and slight swelling, especially on the roof of the mouth and under the chin or the nose.

(2) *Moderate* exposure causes pain and blistering.

(3) *Severe* burns can cause chills, fever or headache. Herpes simplex infections ("fever blisters" or "cold sores") often follow sunburn of the lips.

e. **Treatment.** For mild sunburn, soothing creams will help. Anesthetic sprays and ointments (Solarcaine) are effective but carry a risk of allergic reactions. Extensive first or second-degree sunburn may require hospitalization.

d. **Prevention.**

(1) Clothing (including nose shields).

(2) Baby oil, olive oil, lanolin and coconut oil provide no protection at all.

(3) Sunscreens filter out some ultraviolet radiation.

(4) The SPF (sun protective factor: 2-35+) indicates how much longer you are protected than with no sunscreen at all. Individuals allergic to thiazides or sulfa drugs may also be allergic to sunscreens. You can replace normal sunscreens with hypoallergenic products.

(5) Sun blocks stop all ultraviolet radiation. Apply to areas that sunburn easily and are hard to cover (nose, lips and ears).

f. **Miscellaneous Information.**

(1) The four middle hours of the day receive two-thirds of the day's ultraviolet radiation. The lighter your skins color the more at risk you are.

(2) Many drugs may increase sensitivity to sunlight. These include sulfonamides and their derivatives (Bactrim and Septra), most tetracycline, particularly oxycycline (Vibramycin), which has been recommended for preventing traveler's diarrhea.

(3) Repeated sun exposure over a period of many years produces degenerative changes in the skin, often leading to cancer in lighter skinned individuals.

(4) Ultraviolet exposure is much greater at high elevation than at sea level. At high altitudes, the atmosphere filters out less sunlight. Snowfields and glaciers reflect about 75 percent of the incident ultraviolet radiation, exposing climbers to more radiation. Atmospheric scattering allows ultraviolet radiation to reach climbers shielded from the direct sun.

(5) Sunburn can occur even on an overcast day or during a snowstorm.

Prevent and Treat Snow Blindness.

a. **Definition.** Irritation of the conjunctiva caused by reflection of the sun on the snow.

b. **Cause.** Snow Blindness is the result of excessive exposure to ultraviolet radiation on the surface of the eye.

c. **Signs and Symptoms.**

(1) May develop up to twelve hours later and can last several days.

(2) Eyes feel irritated, dry or full of sand.

(3) Extreme pain upon moving, blinking or exposing to light.

(4) Eyelids swelling; eyes red, excessive tearing and headache.

(5) Complications include corneal ulceration and permanent damage.

Table of Contents

d. **Treatment.**
(1) It often heals spontaneously in a few days with cold compresses and a dark environment for pain relief
(2) Early, hourly application of an ophthalmic medicine also helps.
(3) Do not rub eyes.
(4) Avoid local anesthetics because they may damage the cornea.

e. **Prevention.**
(1) Wear large curved glasses with side covers that block UV radiation from all sides.
(2) Goggles are safer but are less comfortable and may fog.
(3) You can make emergency lenses from cardboard with a thin slit or pinhole to see.

f. **Miscellaneous.** Any source of ultraviolet radiation (sun, ultraviolet lamps, welding equipment) can burn the eye. Just like sunburn of the skin, you may not know it's happening.

Identify Hot Weather Injuries.
Prevent and Treat Heat Exhaustion.

a. **Definition.** Is caused by loss of body fluids through sweating without adequate fluid replacement
b. **Cause.** The excessive loss of salt through heavy sweating and several hours of sustained exertion
c. **Signs and Symptoms.**
(1) Excessive sweating with pale, moist, cool skin.
(2) Headache
(3) Weakness
(4) Dizziness
(5) Loss of appetite
(6) Cramping
(7) Nausea with or without vomiting
(8) Urge to defecate
(9) Chills (goose flesh)
(10) Rapid breathing
(11) Tingling in hands and/or feet
(12) Confusion

d. **Treatment.**
(1) Move to shaded area
(2) Loosen clothing pour water on him and fan him
(3) Slowly drink one canteen of water
(4) Elevate legs
(5) Monitor casualty until symptoms are gone or medical assistance arrives
(6) Check casualty for signs and symptoms of Heat Stroke

e. **Prevention.**
(1) Follow the fluid replacement guidelines for warm weather training
(2) Implement a work rest plan for any activity in a warm weather environment.
(3) Acclimatize

Table of Contents

Prevent and Treat Heat Stroke.

a. **Definition.** The body's normal mechanisms for dealing with heat stress, such as sweating and temperature control are lost. This is a Medical Emergency

b. **Cause.** Normally caused by prolonged exposure to high temperatures.

c. **Signs and Symptoms.**

(1) Elevated or lowered blood pressure
(2) Cessation of sweating
(3) Rapid heartbeat
(4) Irritability, confusion or unconsciousness
(5) Feeling dizzy or lightheaded
(6) Rapid shallow breathing
(7) Skin is red flush, hot, and dry

d. **Treatment.**

(1) Move to shaded area
(2) Loosen clothing pour water on him and fan him
(3) Slowly drink one canteen of water if conscious
(4) Elevate legs
(5) Seek medical assistance
(6) Transport immediately to a Medical treatment facility

e. Prevention.

(1) Follow the fluid replacement guidelines for warm weather training
(2) Implement a work rest plan for any activity in a warm weather environment.
(3) Acclimatize

Table of Contents

Notes:

6 - Mountain Operations

071E9013

INTRODUCTION: Operating in the mountains presents a unit with two particular sets of tactical problems: one, the significant affects that the weather and environment has on personnel, weapons and equipment and two, the significant affects the terrain has on mobility, both mounted and dismounted. Units who can successfully meet these challenges will be more successful in focusing their efforts on fighting the enemy rather than the mountain environment.

General Information on Terrain, Altitude, and Weather

a. **Terrain is broken down into 3 operational levels:**

(1) *Operational Terrain Levels*

(a) **Level I:** Located at the bottom of valleys and along the main lines of communications. Heavy forces can operate, but maneuver space is often restricted. Light and heavy forces are normally combined since vital lines of communications usually follow the valley highways, roads, and trails. Most of the local population base lives in level I therefore in a COIN environment level I may be considered the KEY terrain.

(b) **Level II:** Lies between valleys and shoulders of mountains. Generally, narrow roads and trails, which serve as secondary lines of communication, cross this ridge system. Ground mobility is difficult and dismounted units will expend great effort here as they can easily influence operations at Level I. Similarly, enemy positions at the next level can threaten operations on these ridges. Units in this terrain will greatly benefit from basic mountaineering training and equipment

(c) **Level III:** Includes the dominant terrain of summit regions. Although summit regions may contain relatively gentle terrain, mobility in Level III is usually the most difficult to achieve and maintain. Level III terrain can provide opportunities for well-trained units to attack the enemy from the flanks and rear. At this terrain level, acclimatized Soldiers with advanced mountaineering training can infiltrate to attack lines of communication, logistics bases, air defense sites, and command infrastructures. Units will require highly specialized mountaineering training and equipment to be able to fully operate at this level.

(2) *Commanders* and planners must clearly understand the effect the operational terrain levels have on maneuver and how they interact with each other. They must identify and control dominant terrain at each operational level to facilitate maneuver. They must also think, plan, and maneuver plan vertically. Units who have the motivation and ability to operate in higher levels of terrain will take the initiative away from the enemy who is often accustomed to owning that terrain.

(3) *Compartmented Terrain* (terrain broken up into smaller areas by mountains and ridges) affects on operations:

(a) Ability to switch axis of advances
(b) Mutual support between axis
(c) Restrictions in the commander's mobility
(d) Decreased mobility
(e) Planning based on strict movement timetables
(f) Unit boundaries
(g) Line of sight communications
(h) Increased demands on junior leaders

(4) *Summary*

(a) Terrain has a significant impact on all aspects of operations, especially movement
(b) Units with mountain mobility skills can use terrain to their advantage to achieve surprise or gain the tactical advantage

Table of Contents

b. **Weather affects** personnel, equipment and weapons and must be taken into account when planning operations.

(1) *General*
- (a) Two climate zones (high and low elevation)
- (b) Variety of local climates
- (c) Erratic weather patterns
- (d) Greater precipitation on mountain's windward side

(2) *Temperature*
- (a) Normal drop of 3-5 degrees per 1000' rise
- (b) 40+ degree difference between sun and shade
- (c) Rapid heating and cooling
- (d) Chilled air drains downward
- (e) Temperature inversions
- (f) Usually warmer during a winter storm

(3) *Adverse Weather*
- (a) Gradual lowering of clouds
- (b) Increasing halo around sun or moon
- (c) Increase in humidity or temperature
- (d) Decrease in barometric pressure
- (e) Strong winds (blowing snow off peaks)

c**. Altitude**

(1) *General*
- (a) Proportion of oxygen in air decreases as a Soldier ascends
- (b) Decrease in oxygen can cause
  - Altitude sickness
  - Reduced physical performance
  - Reduced mental performance and decision making

(2) *Acclimatization*
- (a) Allows the body to adapt to the effects of low oxygen saturation
- (b) Factors affecting acclimatization
  - Altitude
  - Rate of ascent
  - Duration of stay
  - Level of exertion

(3) *Hasty Acclimatization*
- (a) Acetazolamide (Diamox) helps accelerate acclimatization
- (b) All Soldiers must know signs of all types of altitude sickness
- (c) Allow for decreased physical performance
- (d) Be prepared to MEDEVAC Soldiers with altitude sickness
- (e) Nutrition and hydration helps significantly

Table of Contents

Execution

a. **Mobility**

(1) *Mountain Effects:*

Dismounted Units must factor in elevation gain and loss into movement time tables. There are only so many routes in the area. The enemy will make use of these and maintain observation on US forces. They may attempt an ambush in choke points particularly if units are unable to maintain situational awareness during patrols.

(2) *Recommendations:*

(a) Add one hour for every 300 meters of ascent and 600 meters of descent

(b) Leaders need to enforce Soldier Load Management as well as mountain walking techniques to ensure Soldiers maintain situational awareness when on patrol. Soldiers must constantly scan with optics and be vigilant when on patrol.

(c) Provide basic mountaineering skills training and equipment to units operating dismounted in the mountains.

b. **Route Selection**

(1) *Mountain Effects*:

The shortest route in the mountains may not always be the best route.

(2) *Recommendations*:

Units must factor in the following when route planning: enemy situation, time available, mountaineering skill of Soldiers, equipment available, Soldier load, natural obstacles, slope of terrain and weather.

c. **Mounted Movement**

(1) *Mountain Effects*:

Trafficable roads in the mountains are few and far between and units must assume Enemy forces are keeping these under observation. Many roads are poorly constructed, in disrepair and are extremely hazardous to travel over.

(2) *Recommendations*:

Units must be prepared to deal with constant breakdowns and repairs as well as have a self recovery capability. Soldiers must conduct extensive PMCS and planning for these contingencies to include rollover drills and water recovery. Drives should have rough terrain driver training as well. Every vehicle should have tow straps at a minimum.

d. **Effectiveness of Weapon Systems**

(1) *Mountain Effects:*

The mountain environment has dramatic effects on how, when and what weapons are employed. Many engagements are at long range, in bad weather and fired from non standard positions and platforms. The enemy often engages from hardened bunker type positions.

(1) Recommendations:

(a) Soldiers must understand the effects extreme cold, winds and high angle have on their weapon systems. Units need to train for longer range engagements on high angle ranges using non standard firing positions and modify their crew served weapons mounts to fire at extreme angle.

Table of Contents

(b) Units should deploy with optics on as many weapons as possible and qualify as many designated marksman as training and time allows. TOW and javelins are very effective at engaging enemy bunker and fortified positions.

e. **Indirect Fires**

(1) *Mountain Effects:*

Mortars are a critical weapon system for both mounted and dismounted operations as they are extremely responsive particularly for direct lay and hip shoot missions. All indirect fire systems to include mortars and field artillery are greatly affected by snow and cold weather. Affects include higher dud rates in the cold and snow, smothering affects i.e. reduction in the fragmentation of rounds upon impact in snow, and a decreased range due to cold temperatures. Typically fire missions in the mountains are at max charge –max elevation which tends to break parts at a higher rate than conventional operations.

(2) Recommendations:

Units deploy with all organic mortar systems and include them whenever possible on both mounted and dismounted patrols. Units may want to train additional mortar personnel whenever possible particularly on the 60mm mortar. Leaders and fire support personnel must understand the affects that cold weather and terrain has on indirect fire operations and compensate for them such as creeping rounds rather than bracketing them when engaging targets on ridgelines.

f. **ISR**

(1) *Mountain Effects:*

Conducting a thorough reconnaissance is critical in the mountains as is understand the enemy's operational patterns in COIN. Enemy forces will keep US positions (COP, FOBs, OPs and GACs) under surveillance and wait for the opportune time to mass their forces for attack.

(2) *Recommendations:*

Units need to have an aggressive counter-surveillance program in affect particularly around remote COPs. Leaders must plan for active patrolling, numerous OPs and leveraging any available assets such as UAS and HUMINT teams. Leaders must make maximum use and plan for the employment of organic assets such as javelin CLUs, TOW ITAS, and the LRAS in static positions such as OPs.

g. **Fixed Wing A/C**

(1) *Mountain Effects:*

Close Air Support (CAS) is greatly affected in the mountains as targets are often not clearly visible due to terrain and weather. Weather may restrict aircraft from support missions and aircraft may be limited to a few routes.

(2) *Recommendations:*

Units should plan for no CAS periods due to weather and have coordinated SOPs for improved target marking such as IR lasers or smoke.

Table of Contents

h. **Rotary Wing A/C**

(1) *Mountain Effects:*

Close Combat Attack (CCA) missions are highly effective in the mountains. Rotary wing aircraft can spend more time on station and often deliver more accurate direct fires than CAS missions. Weather, terrain and elevation all affect rotary wing aircraft as well. At extremely high altitude rotary wing aircraft have limited payloads. Transport helicopters such as UH60s and CH47 have limited carrying capacity at elevation and less range. Limited HLZs in the mountains can focus the enemy on the few know positions.

(2) *Recommendations:*

Leaders need to plan for no CCA periods during extreme weather and have established SOPs for target marking. Early and often coordination with aviation elements is also critical. Leaders need to understand the limitations of rotary wing aircraft at elevation and may have to plan more resources to move the same number of personnel. Leaders need to assume the enemy is aware of most potential HLZs and has them under observation.

Service and Support

a. **Resupply**

(1) *Mountain Effects:*

The ability to resupply forward elements in the mountains is often what leads to success or failure in operations. Particularly for dismounted operations, leaders must plan for resupply to manage Soldier Loads and keep units combat effective.

(2) *Recommendations:*

Leaders must train and plan on several field expedient resupply methods to include speedballs, poncho parachutes and the Low Cost Low Altitude (LCLA) delivery system. Soldiers should also have training and make use of pack animal support whenever possible.

b. **MEDEVAC-CASEVAC**

(1) *Mountain Effects*:

The evacuation of injured personnel in the mountains is very challenging. Steep rough terrain limits dismounted evacuation, treacherous roads and the threat of enemy ambush limits ground evacuation and bad weather and load restrictions can limit air evacuation.

(2) *Recommendations:*

Leaders must plan, rehearse and have contingencies for all three methods of evacuation (dismounted, mounted, air). Soldiers must be trained on rough terrain evacuation methods to include patient packaging in cold weather, lightweight and improvised litters, lowering and raising systems and non standard platforms. Units must make every effort to procure the proper equipment for mountain CASEVAC. Leaders must also anticipate and plan for altitude sickness at higher elevations (8,000 plus feet).

Table of Contents

Command and Signal

a. **Communications**

(1) *Mountain Effects:*

Terrain and weather significantly affect line of sight communications. Extreme operating distances also challenge most FM communications. Radios experience lower battery life in cold weather.

(2) *Recommendations:*

Plan for increased use of NLOS radios such as HF and TACSAT. Plan for the use of retrains teams and stations if using FM and plan for increased battery usage or use more lithium based batteries. Integrate the Primary Alternate Contingency and Emergency (PACE) plans into unit SOPs and have alternate combs systems such as cell phone, SAT phones and MBITR radios available. Ensure all personnel are familiar with the PACE plan for CAS and MEDEVAC.

b. **Leadership**

(1) *Mountain Effects:*

Combat in the mountains is a junior leader fight. Compartmentalized terrain and great distances limit command and control and force junior leaders to make critical decisions on a daily basis. The additional complexities of a COIN fight also add more responsibilities to junior officers and NCOs. Platoon leaders and squad leaders will often have attachments from unfamiliar units such as PSYOPs and CA and have to coordinate with numerous external units and agencies such as SOF and NGOs as well host nation forces such as the ANA and interpreters.

(2) *Recommendations:*

Train junior leaders to make key decisions and allow them to make mistakes in training they will learn from. Integrate role players into field training whenever possible at home station. Train junior leaders to lead from the front and place a high priority on tough, challenging, and realistic field training.

Summary: The two critical elements for success in mountain combat operations are leadership and training. No amount of improved technology or equipment will ever replace those key factors

Table of Contents

Notes:

7 - Characteristics of Mountain Terrain

071E9015

INTRODUCTION: Operating in the mountains exposes Soldiers to some of the most unforgiving terrain on the face of the planet. Moving across glaciers, cliffs, ravines and other dangerous obstacles can easily lead to casualties and mission failure for the unprepared. Having the ability to identify various types of mountain terrain and the associated risks will greatly enhance a unit's ability to successfully conduct mountain operations.

Identify the Features of Mountain Terrain.

a. Mountain terrain is characterized by high peaks, deep valley and ravines, fast moving rivers, glaciers, cliffs, steep slopes, and other hazardous obstacles. These features pose unique challenges to the Soldier operating in the mountains.
b. Mountains are defined as land masses rising more than 500 meters above the surrounding plain. They can be single peaks, a long ridgeline, or an entire range.
c. Glaciers, cliffs, and steep terrain are particular hazards that require specialized training.
d. High alpine environments with exposed movement corridors and compartmentalized terrain over ridgelines, steep spurs and deep draws.

Identify Terrain Classifications.

a. **Class 1.** Class 1 terrain is defined as gentle slope or easy trails. This terrain is negotiated with simple walking techniques. Classified as easy.
b. **Class 2.** Class 2 terrain involves off-trail scrambling in steeper, more rugged terrain. Rarely, use of hands may be needed to negotiate Class 2 terrain. Type 2 terrain is classified as easy.
c. **Class 3.** Class 3 terrain usually necessitates moderate scrambling, with use of hands needed for balance. Use of fixed ropes or belay techniques may be required for beginners. Basic mountaineers may be useful to negotiate this terrain. Classified as moderate terrain.
d. **Class 4.** Class 4 terrain is steeper terrain that involves belayed climbing or fixed ropes. There is moderate to difficult scrambling which may have some exposure. Significant injury can occur if an un-roped fall occurs. Basic mountaineers are needed to negotiate this terrain. Class 4 terrain can be classified as moderate to hard depending on the exposure and the consequences of a fall.
e. **Class 5.** Class 5 terrain is vertical terrain involving hands and feet at all times while moving. This terrain is complex, dangerous ground where significant injury or death can occur from an un-roped fall. Class 5 terrain requires Soldiers to be roped up, use belay techniques, and place intermediate protection. Assault climbers are required to negotiate this terrain. Class 5 terrain should always be considered hard terrain when planning.

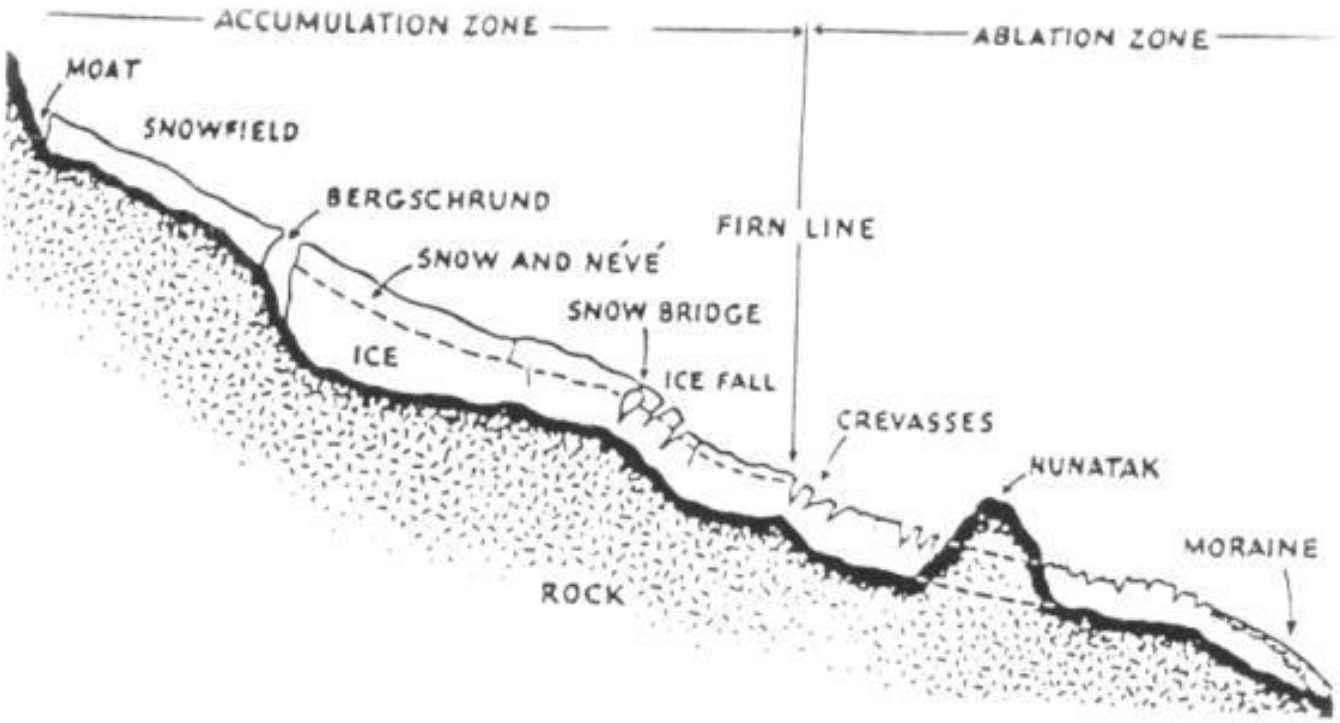
Table of Contents

Identify a Glacier.

a. **Definition.** A moving body of ice that forms on land from the accumulation and compaction of snow, and that flows down slope or outward due to gravity and the pressure of its own weight.

b. Information.

(1) Glaciers cover 10% of the earth's surface.
(2) A solid river of rock, snow and ice.
(3) Forms in areas where more snow falls each year than melts away during warmer seasons.
(4) After many years of accumulation, older-deeper snow forms into solid ice.
(5) Forms over hundreds of thousands of years.



Identify Glacier Hazards.

a. **Dangers.** The dangers and obstacles to movement in glacial areas are crevasses, icefalls, snow bridges and the sun.

(1) *Crevasses***.** The ice cannot adapt itself exactly to terrain it is moving over. The glacial ice is subjected to tremendous pressures and dragged in all directions. Crevasses develop first as simple fissures, later as gaping rifts. The middle of a glacier generally has the fewest crevasses. On a bend, the outside edge will have more crevasses than the inner edge. The roped party should maintain a path at right angles to the general trend of the crevasses. Do not forget that it is possible for the entire party to be walking directly over a wide crevasse.

(2) *Ice falls.* On the steep pitch of a glacier, ice flowing over irregularities and cliffs in the underlying valley floor cause the ice to break into ice blocks (known as Seracs), crisscrossed with crevasses. This jumbled cliff of ice is an icefall. The safest time for movement through icefalls is early in the morning before sunrise.

Table of Contents

(3) *Snow Bridges*. Deep snow hardened by wind can develop into a crevasse bridge. The strength of a snow bridge varies tremendously with temperature. An arch that might support a truck, in the cold of winter or early morning may collapse under its own weight during an afternoon thaw. Cross every bridge with caution every time. Do not assume that because it held in the morning during the ascent that it is safe as you head down in the afternoon.

(4) ***Sun.*** The intense sun on the open surface of a glacier is a serious hazard. At higher elevations, the hazard is greater. There is a thinner cloud layer to filter UV rays. More harmful radiation works on the skin and eyes. The reflective qualities of the snow magnify the effect. Take extra care to prevent sun-induced injuries.

Table of Contents

Notes:

8 - Soldier Load Management
071E9051

INTRODUCTION: How much weight a Soldier carries is a crucial concern for leaders during the planning process. Leaders must carefully consider how much to carry, how far, and in what configuration during mission planning. Leaders must recognize the potential impact of the Soldier's load and ensure they only pack essential items. Rigorous planning and inspection is the key to ensuring Soldiers are not overloaded and capable of accomplishing mission in the mountains. Bottom line: mobility equals lethality, ounces equal pounds, and pounds equal pain.

Conduct Soldier Load Management Guidance.

a. The Soldier's combat load has increased 60% since WWII. Soldiers in divisional combat elements now routinely carry 110-pound loads for extended periods. Technology increases our lethality but also the loads we must bear in combat. Mountain terrain and alpine weather compound the challenges of Soldier load management. It is a leadership challenge to balance these competing impairments to mission success.

b. Soldiers operating on foot in the mountains and in alpine terrain must pack light and smart to maintain a good balance of mobility and lethality. Essentially each piece of equipment a Soldier carries must perform multiple tasks and enhance the mission through lightening the Soldiers overall load.

Identify the Considerations of Soldier Load Management.

a. **Load Carrying Equipment**: The following equipment is carried during combat operations at a minimum: Individual Body Armor (IBA), individual weapons, ammunition, NVG's, flashlight/headlamp, first aid, water. The weight of this equipment varies, but is typically between 30 and 50 pounds. Many Soldiers modify issued LCE or purchase after market gear to fit their body styles and mission. Individual equipment should be set up by each Soldier to ensure quick and easy access to equipment (fast reloads and access to medical supplies). Soldier's individual load should be tailored to and be specific to each mission.

b. **Assault Pack:** The assault pack comfortably carries up to 30 pounds. Adjust the waist and sternum straps to avoid interfering with your LCE – this will reduce fatigue when carrying heavier loads.

c. **Main Pack:** This is the main load hauling system. The ALICE or MOLLE rucksack, including other civilian models, is designed to distribute the load over the hips and shoulders to reduce fatigue. There are certain principles to observe to carry the load most efficiently.

(1) The general principle is that lighter-weight items go at the bottom, heavier items are at the top and close to your body. However, if you are going to be patrolling in rough terrain or snow, pack some of the heavier items a little lower and close to your back to bring down your center of gravity.

(2) The sleeping bag fits into the compartment found at the bottom of most internal frame packs, and the MOLLE pack. This is one of the lightest items, and usually only needed when stopping for the night. Ensure your bag is absolutely protected in a waterproof bag.

(3) Keep often needed items near the top or in an accessible pocket. Some examples of this are sunscreen, bug repellent, raingear if expecting bad weather, snacks and water. These needed items may change depending on the season or the weather report.

(4) Loosen compression straps while packing to get most use from the inside of your pack. Tighten the compression straps before moving out to keep the load stabilized and avoid shifting your center of gravity around.

(5) Avoid hanging items from the outside of the pack – these items catch on branches, and are unnecessarily noisy.

Table of Contents

Considerations: Ensure every item in your kit is necessary – Can you share anything with other members of your squad (stove, filter, etc.)? Can you do multiple things with a single item? Can you live without a few creature comforts for a short duration? Think about carrying the least amount of gear that does the most.

SUMMARY: The cure to operating in a mountainous environment with combat loads dismounted is as simple as following the acronym :

D – Determine level of mobility.
R – Reduce redundant / non – essential equipment.
O – Organize resupply.
P – Police your Soldiers.

Remember the enemy attacks where we are vulnerable. Our vulnerabilities lie in our fatigue due to loads carried during combat patrols in austere environments. Every effort must be put forth to reduce the load carried by the Soldier which will have a direct impact on the reduction of our vulnerabilities.

Notes:

Table of Contents

9 - Mountain Travel Techniques

071E9001

INTRODUCTION: The ability to move efficiently and effectively in broken mountainous terrain is what separates trained mountain units from the untrained. Soldiers must have the knowledge and skills to move through steep, rocky or snow covered terrain in order to close with and destroy the enemy. Mountain Soldiers must be comfortable on snowshoes in the winter and on rock in the summer.

Identify the fundamentals of movement and four types of terrain.

a. Fundamentals of basic mountain movement.

(1) *Technique.* The Soldier's weight is centered over their feet at all times. Place your foot flat on the ground to obtain as much sole contact as possible. Place your foot on the uphill side of grass clumps, small talus and other un-even terrain to avoid twisting ankles and straining your calves.

(2) *Pace.* Pace is adapted to the terrain. The Soldier maintains pace and compensates for changes of slope or terrain by adjusting the length of his stride. A steady and constant pace is enhanced when an interval of three to five paces is kept between Soldiers. This interval helps lessen the "accordion" effect at the end of the file. When an effective pace is set, a unit can cover a given distance in a minimal time and be ready to fight.

(3) *Rest Breaks.*

(a) During the first thirty minutes of movement, an adjustment halt should be taken. Soldiers should loosen or tighten bootlaces as needed, adjust packs and add or remove layers of clothing.

(b) Following the first halt, a party may take a short rest every 1 to 1.5 hours. These halts are kept short to avoid muscles stiffening (one to five minutes).

(c) Later in the march, longer halts may be necessary due to fatigue or mission requirements. At these halts, Soldiers should immediately put on additional clothing to avoid cooling (it is much easier to keep a warm body warm than to warm up a cold one).

(d) After a long climb, a rest may be needed to revive tired muscles.

(4) *Rest Step.* The rest step is used for steep slopes, snowfields and in higher elevations. It controls pace and limits fatigue by giving the lungs and legs a moment to recuperate. Pace is kept slow and rhythmic.

(a) After each step forward, the Soldier pauses briefly, relaxing the muscles of the forward leg while resting his entire body weight on the rear leg. The rear leg is kept straight with the knee locked so that bone, not muscle, supports the weight.

(b) Breathing is synchronized with the rest step. The number of breaths per step will change depending on the difficulty of the climb. Steeper slopes or higher elevations may require several breaths per step. When the air thins at altitude, it is important to breathe deeply.

Note: If side hill travel is necessary, try to switchback periodically and use any lower angle flat areas such as rocks, animal trails and the ground above grass or brush clumps to level off the route.

b. **Four Types of Terrain.**

(1) *Hard Ground.* Hard ground is firmly compacted, rocky soil that does not give way under the weight of a Soldier's step. It is most commonly found under mature forest canopy, in low brush and areas where animals have beaten out multiple trails.

(a) Ascending. When ascending, these slopes can be traversed rather than climbed straight up. To turn at the end of each traverse, the Soldier should step off in the new direction with the uphill foot. This prevents crossing the feet and possible loss of balance. For small stretches, the herringbone step may be used—ascending straight up a slope with toes pointed out. A normal progression, as the slope gets steeper, would be from walking straight up, to a herringbone step and then to a traverse on the steeper areas.

Table of Contents

(b) Descending. Descending is best done by walking straight down the slope without traversing. The Soldier keeps his back straight and bends at the knees to absorb the shock of each step. Body weight is kept directly over the feet and the full boot sole is placed on the ground with each step. Walking with a slight forward lean and with the feet in a normal position makes the descent easier.

(2) *Grassy Slopes.* Grassy slopes can be composed of small clumps of growth rather than one continuous field.

(a) Ascending. When ascending, step on the upper side where the ground is more level

(b) Descending. When descending, the traverse technique should be used because of the uneven nature of the ground. A Soldier can easily build up too much speed and fall if a direct descent is tried.

Note: Wet grass can be extremely slippery. The Soldier must be aware of ground cover conditions.

(3) *Scree Slopes.* Slopes composed of the smallest rocks are called scree slopes. Scree varies in size from gravel to the size of a man's fist.

(a) Ascending. Ascending scree slopes is difficult, tiring and should be avoided. All principles of ascending hard ground and snow apply, but each step is carefully chosen so the foot does not slide down when weighted. This is done by kicking in with the toe of the upper foot (similar to step kicking in snow) so that a step is formed in the loose scree. After determining that the step is stable, weight is transferred to the upper leg. The Soldier then steps up and repeats the process with the next foot.

(b) Descending. The best method for descending scree slopes is to come straight down the slope using a short shuffling step with the knees bent, back straight, feet pointed downhill and heels dug in. When several climbers descend a scree slope together, they should be as close together as possible (one behind the other at single arm interval) to prevent injury from dislodged rocks. Avoid running down scree as this can cause a loss of control. When the bottom of the slope cannot be seen, use caution because drop-offs may be encountered.

(4) *Talus Slopes.* Talus slopes are composed of rocks larger than a man's fist.

(a) Ascending / Descending. . When walking in talus, ascending or descending, climbers should always step on the uphill side of rocks and stay alert for movement underfoot. Disturbing unstable talus can cause rockslides. Climbers must stay in close columns while walking through talus so that dislodged rocks do not reach dangerous speeds before reaching lower Soldiers. To prevent rock fall injuries, avoid traversing below other climbers.

(5) *Other Terrain.*

(a) Snow Slopes. Snow-covered terrain can be encountered throughout the year in many mountainous areas. The techniques for ascending and descending snow slopes are similar to walking on hard ground, grassy slopes and scree.

(b) Thick Brush. Brush-filled gullies can provide routes and rally points concealed from observation. On the other hand, steep brushy terrain is difficult to negotiate. Cliffs and steep ravines are hidden traps. Blow downs and thickets can obstruct travel as much as manmade obstacles. When brush must be negotiated, take the most direct route across the obstacle, look for downed timber to use as raised paths or create a tunnel through the obstacle by prying the brush apart, standing on lower branches and using upper limbs for support.

c. **Safety Considerations.** Mountain walking techniques are designed to reduce the hazards of rock fall and loss of control. Carelessness can cause the failure of the best-planned missions.

(1) Whenever a rock is kicked loose, the warning, "Rock!" is shouted immediately near vertical terrain. Personnel near the bottom of the cliff immediately lean into the cliff to reduce their exposure and do not look up. Personnel more than 3 meters away from the bottom of the cliff may look up to determine where the rock is heading and seek cover. Lacking cover, personnel should anticipate which way the rock is falling and move out of its path.

(2) If a Soldier slips or stumbles on sloping terrain (hard ground, grass, snow or scree) he must immediately self-arrest, digging into the slope with hands, elbows, knees and toes. If he falls backwards, he must immediately try to turn over onto his stomach with his legs downhill and self-arrest with hands and toes.

(3) When traveling through steep terrain, Soldiers should be trained in the use of the ice axe for self-arrest. The axe can be used to arrest a fall on solid ground, grass and scree as well as snow. It may also be used as a third point of contact on difficult terrain. If not in use, the ice axe is carried in or on the rucksack.

Move on Snowshoes.

a. **Snowshoe Technique.**

(1) *Striding Technique.* In taking each stride, the toe of the snowshoe is lifted forward conserving energy by lifting no higher than is necessary to clear the snow. The tail slides over the snow. If the front of the snowshoe catches, the foot is pulled back to free it and then lifted before proceeding with the stride. The best and least fatiguing method of travel is a loose-kneed, rocking gait in a rhythmic stride. Avoid stepping on or catching the other snowshoe.

(2) *Gentle Slopes.* On gentle slopes, climb straight up to ascend.

(3) *Steep Slopes.* Ascend steeper terrain by traversing and packing a trail across it. When climbing, the snowshoe is placed as horizontally as possible in the snow. On hard snow, the snowshoe is placed flat on the surface with the toe of the higher one diagonally uphill to get more traction. Traction is very poor on hard-packed or crusty snow. If the snow is hard enough to support the weight of a person it is better to remove the snowshoes and proceed on foot.

(4) *Turning.* When turning around, the best method is to swing the leg up and turn in the new direction.

(5) *Additional Considerations.* Step over obstacles such as logs, tree stumps, ditches and small streams. Take care not to place too much strain on the snowshoe ends by bridging gaps, as the frames may break. In shallow snow, there is a danger of catching and tearing the webbing on tree stumps or snags. Wet snow will frequently ball up under the feet, interfering with comfortable walking. Knock the snow off with a stick or pole when possible. Although ski poles are generally not used in snowshoeing, one or two poles are desirable when carrying heavy loads, especially in mountainous terrain. You may cut off circulation and frostbite may occur if bindings are too tight. During halts, bindings should be checked for fit and possible readjustment.

b. Training. Snowshoe training requires little technical skill. You can learn the technique in a few periods of instruction. Stiffness and muscle soreness can be expected, increasing with loads and distances covered. A good conditioning program must be used to develop muscles seldom used in ordinary marching. Training should be progressive, with ample time allowed for the individual to gain proficiency, gradually increasing the distance covered and weight carried or pulled. Train to overcome obstacles such as dense brush, fallen timber, and ditches. Stress breaking trail with frequent changes of lead men. You can accomplish snowshoe training concurrently with other training requiring individual cross-country movement.

c. **Employing and Carrying Weapons on Snowshoes.**

(1) The purpose of using skis or snowshoes in combat is to speed up the movement of individuals over deep snow. This also exposes them to hostile fire for the shortest possible time. Individuals using snowshoes may keep them on through all phases of the attack.

(2) As friendly forces approach the effective range of enemy weapons, they move by fire and maneuver. Individuals proceed by short rushes on foot, on skis, or on snowshoes, whichever is most feasible. When rushing on foot or on snowshoes, the weapon should be readily available for action.

(3) When contact with the enemy is not expected, carry your individual weapon across your back with the sling over either shoulder. Keep the butt at the side of or attached to your rucksack (if carried). When contact with the enemy is imminent, sling the weapon around your neck and in front of your body. When you establish contact with the enemy, carry your weapon in both hands so the weapon is readily available for action.

(4) Under conditions where the depth of the snow is less than 20 inches (50cm) snowshoes might slow you down. Leave snowshoes in the objective rally point if they hamper mobility during the assault. After you seize the objective, recover snowshoes and bring them forward.

Table of Contents

10 - Anchors
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INTRODUCTION: Safe anchors are a fundamental component to mountaineering. Your ability to quickly and safely establish a strong anchor with minimal gear will greatly enhance your unit's mobility in the mountains. Anchors are used to belay climbers, lower casualties, and establish numerous types of rope installations required to move through terrain that untrained units may find impassable.

Identify considerations of natural anchors.

a. **Natural Anchors.** Natural anchors should be considered for use first. They are very strong and often simple to construct with minimal use of equipment. Trees, boulders and other terrain features are already in place and simply require a method of attaching the rope. However, natural anchors should be carefully studied and evaluated for stability and strength before use. Sometimes the climbing rope is tied directly to the anchor, but under most circumstances a sling is attached to the anchor and then the climbing rope is attached to the sling with a carabiner(s).

b. **Trees.** Trees are the most widely used of all natural anchors. They must be carefully checked for suitability.

(1) In rocky terrain, trees have a very shallow root system. Pushing or tugging on the tree to see how well it is rooted can check this. Anchor low to prevent excess leverage on the tree.

(2) Use padding on soft, sap producing trees to keep sap off ropes and slings.

Trees Used as Anchors

c**. Boulders.** Boulders and rock projections make ideal anchors. The rock can be firmly tapped with a piton hammer to ensure it is solid. Loose rock formations are not stable. Talus and scree fields indicate that the rock in the area is not solid. Pad all areas around the rock formation that could cut the rope or sling.

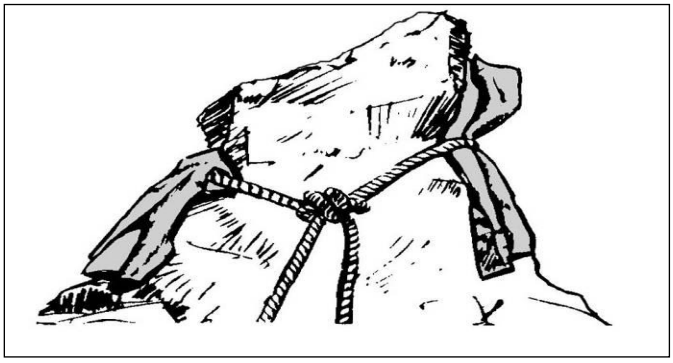


Table of Contents

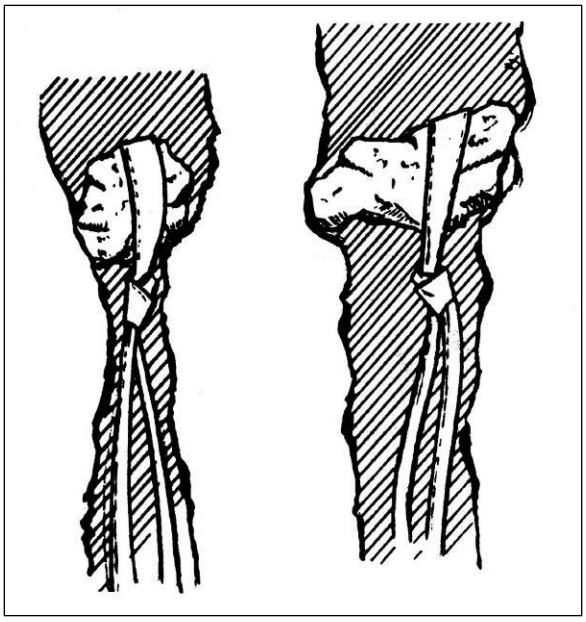
Boulder/Rock Projection Used as an Anchor

d. **Chockstones.** A chockstone is a rock that is wedged in a crack because the crack narrows downward. Chockstones should be checked for strength, security, crumbling and should always be tested before use. All chockstones must be solid and strong enough to support the load. They must have maximum surface contact and be well tapered with the surrounding rock remaining in position.

(1) Chockstones are directional. They are secure when pulled in one direction but may pop out if pulled in another direction.

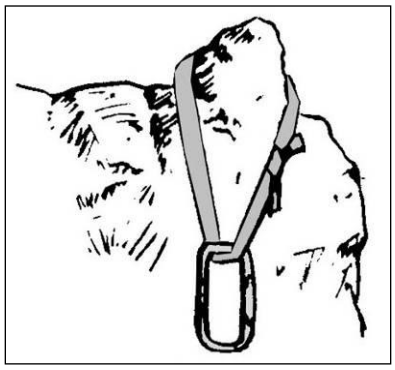
(2) A creative climber can often make his own chockstone by wedging a rock into position and tying a rope or sling to it.

(3) Slings should not be wedged between the chockstone and the rock wall since a fall could cut the sling.



Chockstones

e. **Rock Projections.** Rock projections often provide suitable protection. These include blocks, flakes, horns, and spikes. If rock projections are used, their firmness is important. They should be checked for cracks or weathering that may impair their strength. If any of these signs exist, the projection should be avoided.



Rock Projections

Table of Contents

f. **Tunnels and Arches.** Tunnels and arches are holes formed in solid rock and provide one of the more secure anchor points because they can be pulled in any direction. A sling is threaded through the opening hole and secured with a joining knot or girth hitch. The load-bearing hole must be strong and free of sharp edges (pad if necessary).
g. **Bushes and Shrubs.** If no other suitable anchor is available, routing a rope around the bases of several bushes can use the roots of bushes. As with trees, the anchoring rope is placed as low as possible to reduce leverage on the anchor. All vegetation should be healthy and well rooted to the ground.

Identify Single Point Anchor Techniques.
a. **Slinging Techniques.** There are many methods used to attach slings or cords to a natural anchor. Whichever method is used, the knot is set off to the side where it will not interfere with normal carabiner movement. The carabiner gate should face away from the ground and open away from the anchor for easy insertion of the rope.

Note: When a locking carabiner cannot be used, two carabiners are used with gates opposite and opposed. Correctly opposite and opposed gates should form an "X" when opened.

Figure 5
Correctly Opposed Carabiners

(1) Single Loop Method. Drape the sling over the anchor. Untying the sling and routing it around the anchor and then retying is still considered a single loop method.
(2) Double Bight Method. Wrap the sling around the anchor and connect the two ends together with a carabiner(s).
(3) Girth Hitch. Tie the sling around the anchor with a girth hitch. Although a girth hitch reduces the strength of the sling, it allows the sling to remain in position and not slide on the anchor.
(4) Overhand. To prevent tri-loading of a carabiner or if you want to keep the webbing in position, you can tie an overhand.

Table of Contents

Figure 6 Single-Loop Method	Figure 7 Double-Bight Method	Figure 8 Girth Hitch

h. **Anchoring With the Rope.**

(1) *Direct.* The climbing or installation rope can be tied directly to the anchor using several different techniques. This requires less equipment, but also sacrifices some rope length to tie the anchor. The rope can be tied to the anchor using an appropriate anchor knot such as a bowline, three-loop bowline or a rerouted figure eight. Round turns can be used to help keep the rope in position on the anchor.

(2) *High Strength Tie off.* The high strength tie off is used to anchor the rope on high-load installations such as bridging. The wraps of the rope around the anchor absorb the tension of the installation and keep the tension off the knot and carabiner. The anchor is tied with a minimum of two wraps to absorb the tension. The rope is wrapped from top to bottom. A fixed loop is placed into the end of the rope and attached back onto the rope with a locking carabiner.

Figure 9
High Strength Tie-Off (AKA Tensionless Anchor)

Identify Artificial Anchors.

a. **Artificial Anchors**. Artificial anchors become necessary when natural anchors are unavailable. Choosing and placing good anchors requires a great deal of practice and experience. Artificial anchors are available in many different types such as pitons, chocks, bolts, SLCDs, ice screws, deadmen, and snow pickets. Anchor strength varies greatly. The type used depends on the terrain, equipment, rock and ice quality and the load to be placed on it.

Table of Contents

b. **Pitons.** Pitons have been in use for over 100 years. Although still available, pitons are not used as often as other types of artificial anchors due primarily to their impact on the environment. Most climbers prefer to use chocks, SLCDs and other artificial anchors rather than pitons because they do not scar the rock and are easier to remove.

(1) *Advantages.*

(a) Depending placement, pitons can support multiple directions of pull.

(b) Pitons are less complex than other types of artificial anchors.

(c) Pitons work well in very thin cracks.

(2) *Disadvantages.*

(a) During military operations, the distinct sound created when hammering pitons is a tactical disadvantage.

(b) Due to the expansion force of emplacing a piton, the rock could spread apart or break causing an unsafe condition.

(c) Pitons are more difficult to remove than other types of artificial anchors.

(d) Pitons leave noticeable scars on the rock.

(e) Pitons are easily dropped if not tied off when being used.

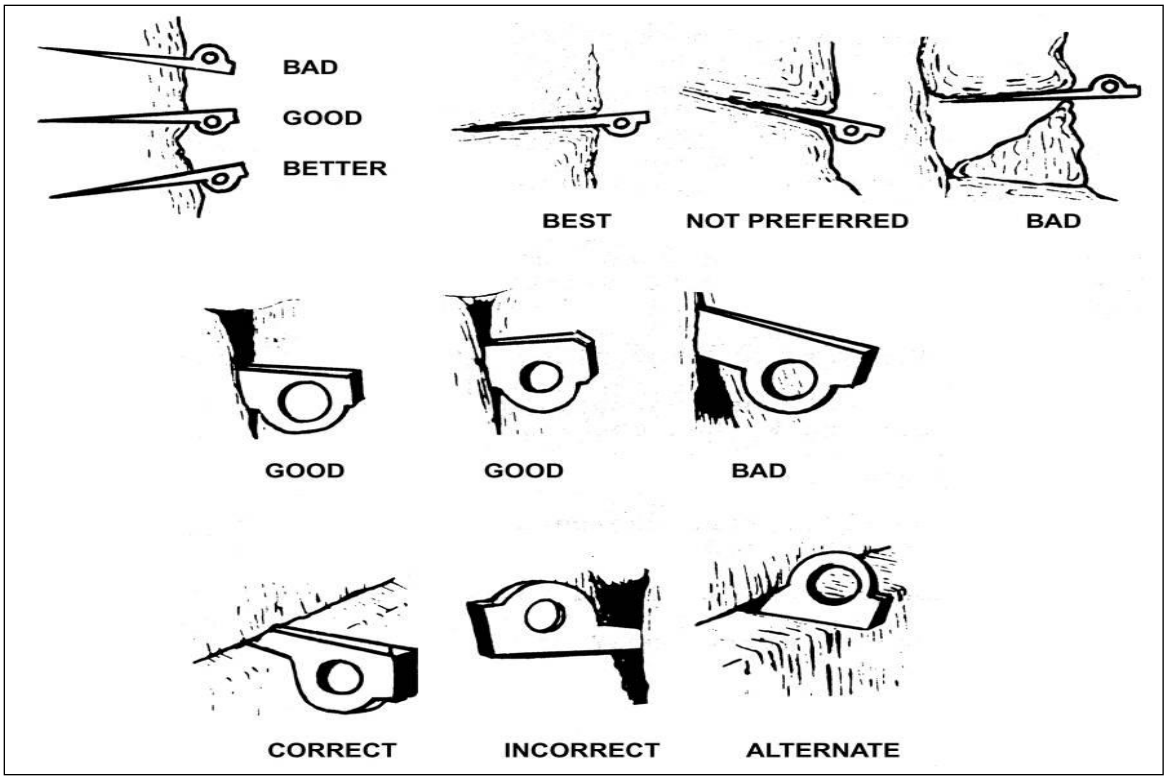
(3) *Piton Placement.* The proper positioning or placement of pitons is critical. A properly sized piton for a rock crack will fit one-half to two thirds into the crack before being driven with the piton hammer. This helps ensure the depth of the crack is adequate for the size piton selected. As pitons are driven into the rock the pitch or sound that is made will change with each hammer blow, becoming higher pitched as the piton is driven in.

(a) Test the rock for soundness by tapping with the hammer. Driving pitons in soft or rotten rock is not recommended. When this type of rock must be used, clear the loose rock, dirt and debris from the crack before driving the piton completely in.

(b) While it is being driven, attach the piton to a sling with a carabiner (an old carabiner should be used, if available) so that if the piton is knocked out of the crack, it will not be lost. The greater the resistance while driving the piton, the firmer the anchor will be. The holding power depends on the climber placing the piton in a sound crack, and on the type of rock. The piton should not spread the rock, thereby loosening the emplacement.

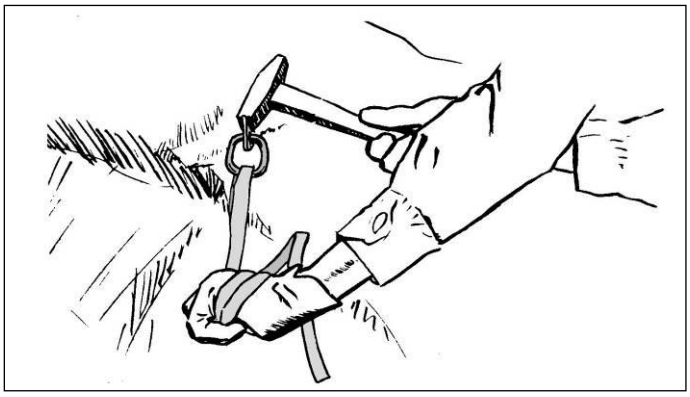
Note: Pitons that have rings as attachment points might not display much change in sound as they are driven in as long as the ring moves freely.
Note: Eye protection should always be worn when driving a piton into rock.
Note: The proper use and placement of pitons, as with any artificial anchor, should be studied, practiced and tested while both feet are firmly on the ground and there is no danger of a fall.

Table of Contents



Piton Placements

(4) *Removing Pitons.* Attach a carabiner and sling to the piton before removal to eliminate the chance of dropping and losing it. Tap the piton firmly along the axis of the crack in which it is located. Alternate tapping from both sides while applying steady pressure. Pulling out on the attached carabiner eventually removes the piton.



Piton Removal

(5) *Types and Characteristics of Pitons.* Most pitons are classified as blades or angles, although there are several other shapes and sizes.

(a) Blade Pitons. Use vertical pitons for flush, vertical cracks; horizontal pitons for flush, horizontal cracks; wafer pitons for shallow vertical or horizontal cracks.

(b) Angle Pitons. Use angle pitons for wide cracks. Place them with the open side down in horizontal cracks and against either wall in vertical cracks.

Table of Contents

c. **Chocks.** Chock craft has been in use for many decades. A natural chockstone, having fallen and wedged in a crack, provides an excellent anchor point. Sometimes these chockstones are in unstable positions, but can be made into excellent anchors with little adjustment. Chock craft is an art that requires time, technique and practice to master. Imagination and resourcefulness are key principles to chock craft. The skilled climber must understand the application of mechanical advantage, vectors, and other forces that affect the belay chain in a fall.

(1) *Advantages.*

(a) Tactically quiet installation and recovery.

(b) Reusable unless severely damaged.

(c) Light to carry.

(d) Easy to insert and remove.

(e) Minimal rock scarring as opposed to pitons.

(f) Sometimes can be placed where pitons cannot (expanding rock flakes where pitons would further weaken the rock).

(2) *Disadvantages.*

(a) May not fit in thin cracks, which may accept pitons.

(b) Often provide only one direction of pull.

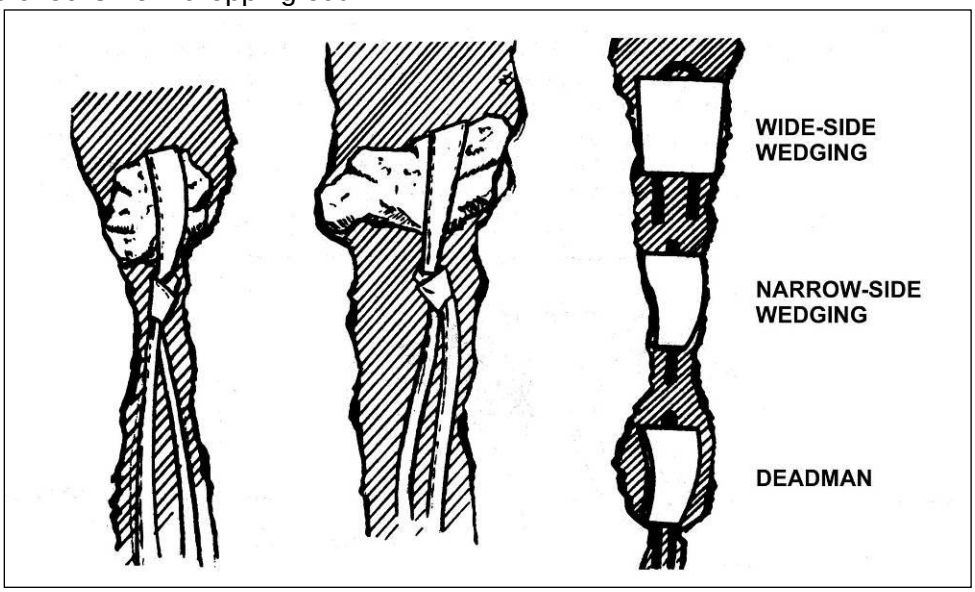
(c) Practice and experience necessary to become proficient in proper placement.

(3) *Placement.* The principles of placing chocks are to find a crack with a constriction at some point, place a chock of appropriate size above and behind the constriction and set the chock by pulling down on the chock loop. Maximum surface contact with a tight fit is critical. Chocks are good for a single direction of pull.

(a) Avoid cracks that have crumbly (soft) or deteriorating rock. Some cracks may have loose rock, grass and dirt, which should be removed before placing the chock. Look for a constriction point in the crack and then select a chock to fit it.

(b) When selecting a chock, choose one that has as much surface area as possible in contact with the rock. A chock resting on one small crystal or point of rock is unsafe. A chock that sticks partly out of the crack is dangerous. Ensure that the chock has a wire or runner long enough; extra ropes, cord or webbing may be needed to extend the length of the runner.

(c) Parallel-sided cracks without constrictions are a problem. Chocks used in this situation rely on camming principles to remain placed. Weighting the placement with extra hardware is often necessary to keep the chocks from dropping out.



Chock Placements

Table of Contents

(4) *Testing.* After seating a chock, test it to ensure it remains in place. A chock that falls out when the climber moves past it is unsafe, dangerous and offers no protection. To test it, firmly pull the chock in every anticipated direction of pull. Some chock placements fail in one or more directions; use pairs of chocks in opposition.

d. **Spring-Loaded Camming Devices** (SLCDs). The SLCD is a spring-activated camming device. It was developed to provide reliable placements in cracks where ordinary chocks are difficult or impossible to place, (i.e. parallel-sided cracks, flaring cracks and cracks under roofs). A SLCD can be placed quickly and be very convenient (saving time and effort in places where protection is needed and ordinary chocks would be tricky and time consuming to place).

Spring Loaded Camming Devices

(1) *Placement.* SLCDs are easy to place. Just hold it like a hypodermic syringe, pull the trigger, place it in the crack and release the trigger.

(2) *Removal.* Pull the trigger and gently remove.

(3) *Miscellaneous*

(a) There should be as much surface area as possible between the camming lobes of the device and the rock.

(b) Avoid placing the lobes on small crystals.

(c) The cams should always be placed between 1/3 and 2/3 of its expansion range. If the bar must be pulled all the way, back to get it into the crack, it may be impossible to remove. Use a smaller size.

(d) Do not place the SLCD any deeper into the crack than necessary. It may be impossible to reach the trigger for removal.

(e) When placed behind flakes or in deep cracks, SLCD have been known to "walk up" into the crack out of reach, as a result of rope action. SLCD should be extended with a runner in such placements.

Table of Contents

(f) SLCDs should always be placed so the direction of pull is parallel to the shaft or it can rotate and pull out.

(e) SLCDs produce tremendous force on the rock when loaded. The rock around the placement must be solid. Avoid placements behind thin or loose flakes.

e. **Bolts**. Bolts are used where cracks are not available.

(1) Bolts provide one of the most secure means of establishing anchors. The rock should be inspected for evidence of crumbling, flaking, cracking and can be tested with a hammer. Placing a bolt with a hammer and a hand drill is a time-consuming and difficult process that requires drilling a hole in the rock deeper than the length of the bolt. This can takes up to 20 minutes for one hole in hard rock. Battery powered or even gas-powered drills can be used to greatly shorten drilling time. However, their size and weight can make them difficult to carry.

(2) A hanger and nut are placed on the bolt; the bolt is inserted and then driven into the hole. A climber should never hammer on a bolt to test or "improve" it, since this permanently weakens it. Bolts should be used with hangers, carabiners and runners.

(3) Some bolts are available in which the sleeve is hammered and turned into the rock (self-drilling), which bores the hole. Split bolts and expanding sleeves are the most common types of bolts. Surgical tubing is useful in blowing dust out of the holes. Nail type bolts are placed by driving the nail with a hammer to expand the sleeve against the wall of the drilled hole.

Note: Safety glasses should always be worn when placing bolts.

Bolt with Expanding Sleeve

f. **Snow and Ice Anchors**.

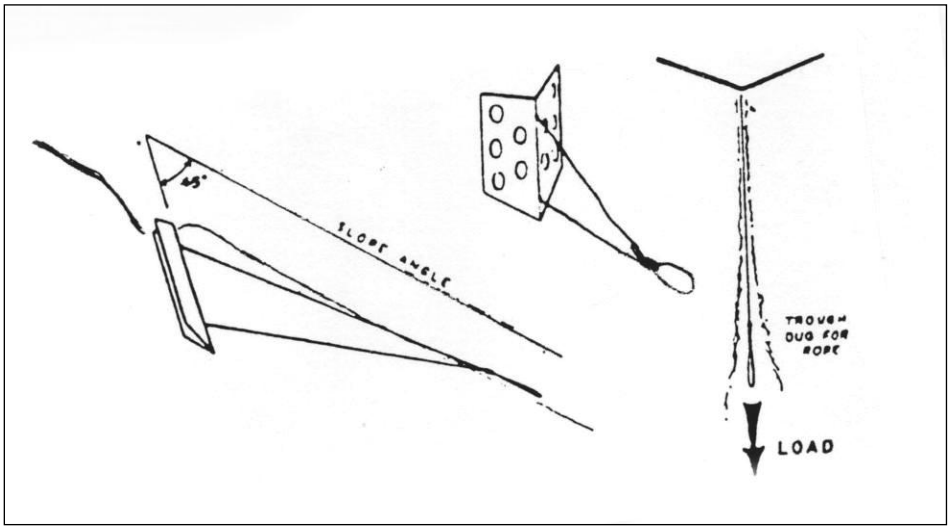
(1) *The ice axe:* The ice axe can be a superb anchor in suitable snow conditions. However, oftentimes snow is either too hard or too soft for an ice axe anchor to be effective. Other anchors must be found.

(2) *Snow pickets:* Snow pickets are stakes, angled or T-shaped, made of aluminum with holes drilled along its length for carabiner attachment. They can be used as stakes or buried in the snow as deadmen (see deadmen). They are made in a variety of lengths to suit snow conditions.

(3) *Deadmen:* A deadman is a rectangular aluminum plate. Bury or pound a deadman in the snow at an angle approximately 45-degrees away from the direction of the load. A steel cable with a loop in the end to clip into, runs perpendicular from the plate toward the belayer. Set the deadman in the snow. Arrange the suspension to pull harder on the inner end. Table of Contents

The harder it is loaded, the deeper it is buried when loaded. This sounds like it provides absolute security in very soft snow, but there are some problems. If a deadman is not set at the proper angle, it can pull out. It can dig into the snow until it hits ice or an old hard crust that causes it to glance off and pull out.

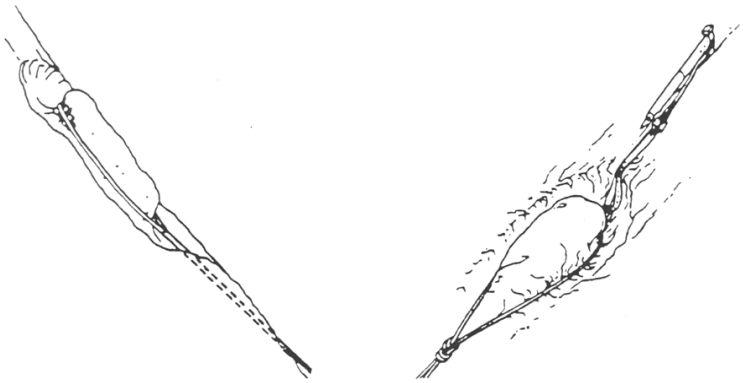
(a) When working in soft snow, bury the deadman as deep as possible. In hard snow, it is necessary to hammer the plate in or to cut a suitably shaped slot. Remember; do not disturb the snow between the plate and the direction of pull except to cut a slot for the cable. Cut this narrow slot in all types of snow. Viewed from above, the wire must be at right angles to the plate. If possible, test-load the anchor to ensure proper seating.



Snow Deadman

(4) *Other Deadman-type Anchors.* Bury an ice axe or picket horizontally across the slope as deep as possible and tie in to the middle of the shaft with a Prusik knot. A pack stuffed into a hole and then buried can also make a good anchor.

(5) *Snow / Ice Bollard.* The bollard or horseshoe anchor is the most valuable. This constructed "horn" is simple and efficient. The major drawback is construction time.



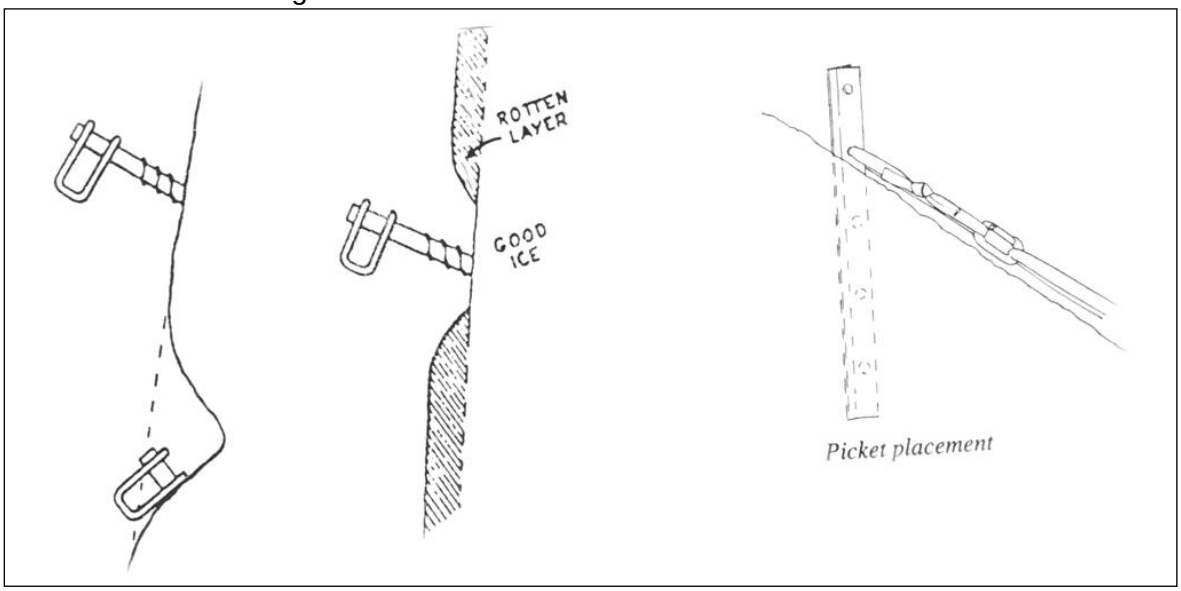
Bollard

(a) The strength of a bollard depends on its size and to the hardness of the snow or ice. Even in soft snow, a properly constructed bollard can hold hundreds of pounds, and on ice, it can be so strong that the rope is the weak link Table of Contents

(b) A bollard on ice needs to be only one foot in diameter, but on soft snow, is must be broader and deeper. Ten feet across and eighteen inches deep. If the snow is compactable, you should pack it down before you cut a groove for the rope. Do not leave any slack in the anchor rope and make sure you shape the slot like the head of a mushroom so that the rope cannot jump out.

(6) *Ice screws:* Use ice screws to establish anchor points. Ice screws are threaded and are placed into the ice by hand and then turned like a screw.

(a) Clear away any rotten ice before placing a screw, and angle the screw a few degrees away from the direction of pull. It is possible to place a foot long screw in just a few seconds. It is ideal to place the ice screw so that the hanger is flush with the surface of the ice.



Ice Screws/Picket

(b) To use multiple screws or pitons in a load-sharing anchor, join them together using the same techniques as you would for rock anchors. Space the screws offset to avoid fracturing the ice.

(7) *V-threads.* A properly placed V-thread is stronger than a screw because the surface area of the ice supporting your weight is much greater than that of the threads on an ice screw. They take practice to construct and get good at, but once learned are invaluable as anchors. To place a V-thread:

(a) Find the area of solid ice that has the least air pockets or cracks through it.

(b) Place the longest screw you can in the ice, at an angle and location that will allow you to drill another screw to meet the first hole. It is sometimes easier to leave the first screw partially in the ice so you can use it as a gauge for the correct angle and location for the second screw. You will be able to see the second screw intersect the hole from the first. The two holes should be 4-6 inches apart for maximum strength.

(c) Push a piece of cord or webbing through one hole and pull it out the other with the thread tool. A thread tool is a 12-inch section of coat hanger bent into a hook on one side and a loop for hanging a carabiner on the other side.

(d) Tie the ends of the cord together with a joining knot. If the hole is shallow, cracked, or in hollow ice, move and try again.

Identify Earth Anchors.

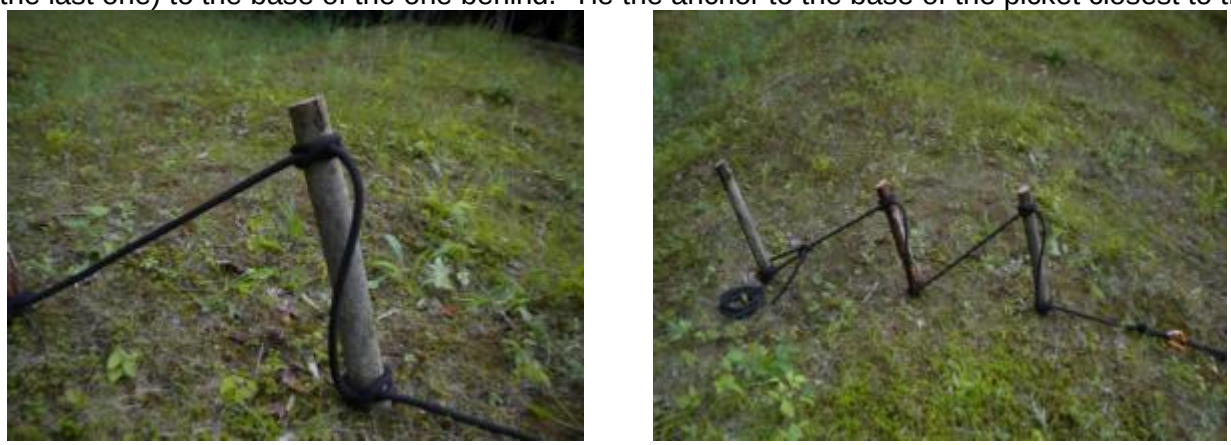
a. **Earth Anchor.**

(1) *Dead-man.* A "dead-man" anchor is any solid object buried in the ground and used as an anchor. An object that has a large surface area and some length to it works best. Large boulders can be used, as well as a bundle of smaller tree limbs or poles. As with natural anchors, ensure timbers and tree limbs are not dead or rotting and that boulders are solid. Table of Contents

Equipment, such as skis, ice axes, snowshoes, and rucksacks, can also be used if necessary. In extremely hard, rocky terrain a variation of the dead-man anchor can be constructed by building above the ground. The sling is attached to the anchor, which is set into the ground as deeply as possible. Boulders are then stacked on top of it until the anchor is strong enough for the load. Though not as strong as when buried, this method can work well for light-load installations as in anchoring a hand line for a stream crossing.

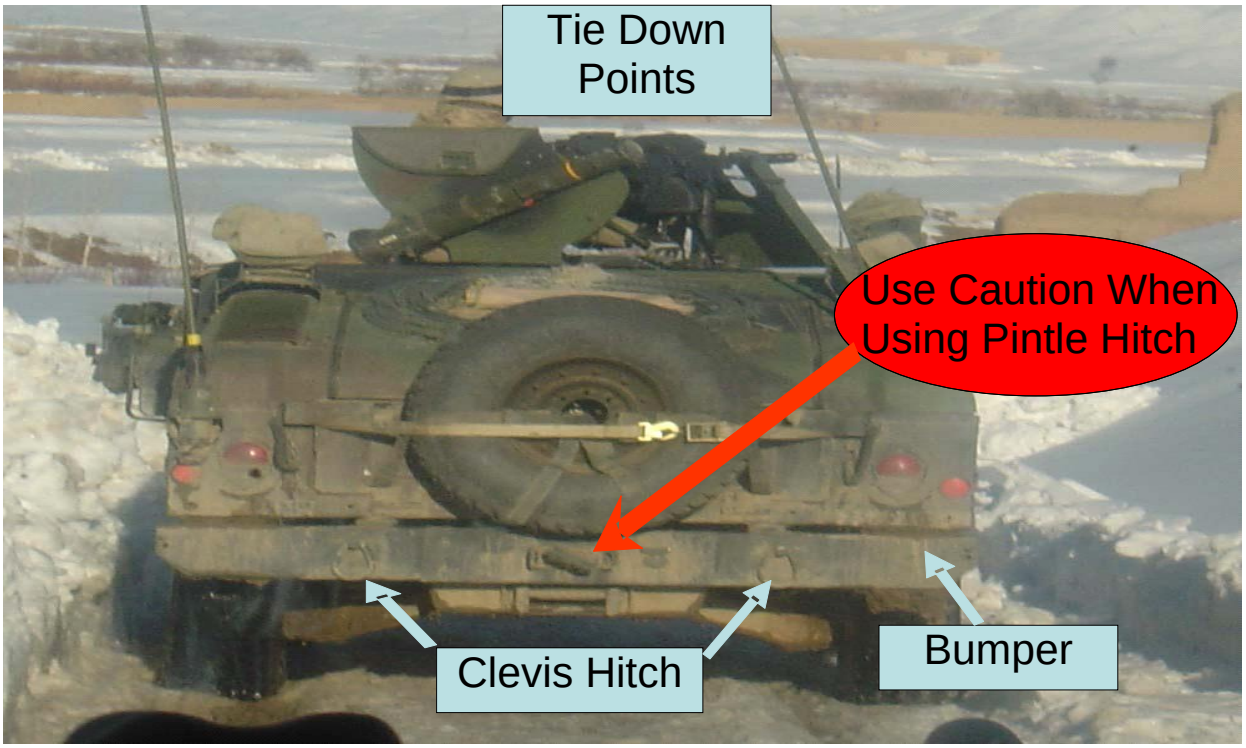
Figure 10
Dead-man Anchor

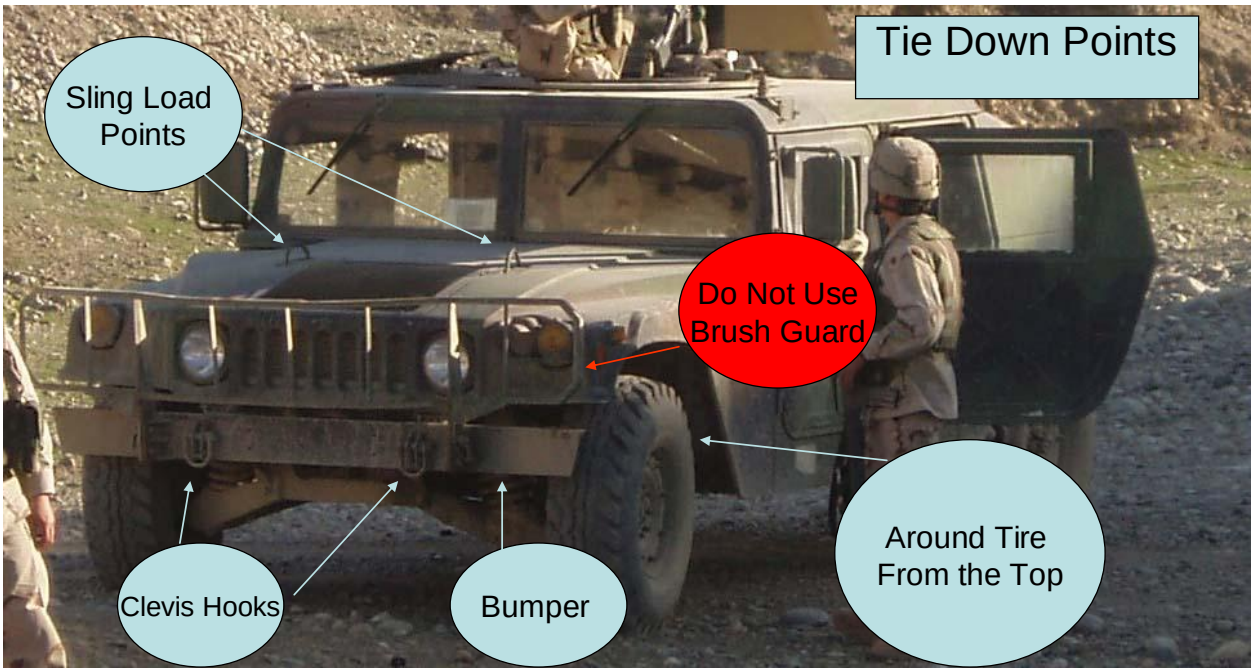
(2) *Picket holdfast.* The picket holdfast is easier to construct but will not hold as well as the dead-man. Drive pickets (at least 2 meters long and 8 cm in diameter) one meter into the ground and 1 to 2 meters apart. Align one behind the other, each 90 degrees to the direction of pull. Tightly lash the head of each picket (except the last one) to the base of the one behind. Tie the anchor to the base of the picket closest to the load.



Identify Vehicle Anchor Considerations.

a. Vehicles can oftentimes be used as anchor points for many situations rather quickly provided there is sufficient access. Care must be taken to ensure that parking brakes are applied and wheels are adequately chalked. One must also make certain that appropriate attachment points are selected and care is taken to protect all rope and webbing from sharp edges. Always be cautious and conservative when using vehicles as anchors for any technical rope work. Table of Contents

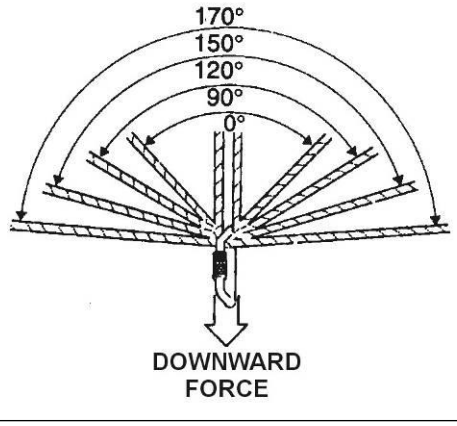




Identify Considerations of Equalizing Multiple Point Anchors.

a. **Multiple Anchor Systems.** Joining the strength of many single anchor points together may be necessary when the individual anchors are not substantial enough for the load on their own. You may construct these systems with natural, artificial or a combination of both types of anchors. The preferred technique is called pre-equalized. For use the direction of pull must be reasonably predictable.

b. Angles. The angle formed by the rope or runner going to the load effects the weight distribution to the anchors of a dual anchor arrangement.



TENSION IN MULTIPLE ANCHOR RIGGING	
ANGLE	RESULTING LEG TENSION*
170⁰	1150%
150⁰	200%
120⁰	100%
90⁰	70%
0⁰	50%
*On each leg relative to downward force.	

Figure 23
Effects of Angles on Anchors

Table of Contents

Identify Methods of Equalizing Multiple Point Anchors.

a. **Pre-equalized Systems.** With an endless loop clip one strand through a carabiner in each anchor. Pull a bight down between each anchor and adjust all the bights in the direction of force. Tie them off with a double figure eight loop.

b. Pre-equalizing two natural anchors such as trees oftentimes does not require the use of carabiners at the anchor. To use this method simply attach one end of a cord or short length of rope to one tree with a bowline, then attach the other end to the other tree in the same way. Then grasp the rope in the direction the anchors will be loaded and tie a double figure of eight loop. Ensure angles are appropriate.

Pre-Equalized Anchor

Identify Techniques for Rappel Anchors.

a. **Non-Retrievable Rappel Point**.

(1) Rappels less than ½ The Rope Length. Double the rope and tie a three-loop bowline around each anchor. Use correct anchor knot for selected site (i.e. three loop bowline, two-loop figure eight, MOR clove hitch with bowline, etc).

(2) Rappels Greater Than ½ the Rope Length. Use two ropes. Tie the end of the rope off correctly. Repeat with the second rope.

(3) Place knots at ends of rope to prevent from rappelling off.

b. **Retrievable Rappel Point.**

(1) Retrievable Rappels Less Than ½ the Rope Length.

(a) Place the middle of the rope around or in the anchor.

(b) Tie a figure eight knot at both ends of the rope to avoid rappelling off the end.

(c) Use both sections of the rope to descend.

(d) When finished, pull on one section of the rope to retrieve.

(e) If the rappel rope catches on something when pulled and one end is out of reach, you have the choice of leaving the rope or climbing unroped to free it. To avoid this, the first person untangles the rappel ropes while descending and those following will attempt to do the same. Before the last person comes down, someone pulls one end of the rope to make certain it can be retrieved easily.

(2) Retrievable Rappels Greater than ½ the Rope Length.

(a) Join the ends of two ropes together with a double overhand knot with 12-18" pigtails. Tighten each strand of rope individually.

(b) Place the joined ropes around the anchor with the joining knot offset.

(c) When you reach the bottom of the rappel pull on the end of rope that has the joining knot.

(d) Pull the rope steadily so the free end will not whip and wrap around anything. Call "ROPE" loudly before the rope falls. When the top anchor is set back from the edge, take the end of the rope to be pulled and walk away from the cliff to lessen the angle of the rope and allow it to be pulled more easily.

Note: Keep track of which rope is "clean" and which rope has a knot tied in it.

Rappel Anchors Chart

Anchor Type	Training Site (2 fixed lines)	Retrievable
Tree anchor, < half rope length	Triple bowline at tree	Middle of rope at back of tree
Multi-point anchor, < half rope	Double Figure of Eight clipped to carabiners at hotpoint	Middle of rope clipped into hotpoint
Tree anchor, > half rope length	2 ropes, each tied off with bowline at tree	2 ropes joined with joining knot just offset from tree
Multi-point anchor, > half rope length	2 ropes, each tied with double Figure of Eight clipped to carabiners at Hotpoint	2 ropes joined and clipped to carabiners at hotpoint, joining knot just offset from hotpoint

Table of Contents

Notes:

11 - Mountain Weather

071E9061

INTRODUCTION: Weather forecasting is as much of an art as a science. Despite all of today's technology, exact weather conditions cannot reliably be forecasted beyond three days. Understanding basic weather patterns will allow you to predict likely conditions and understand their impact on missions. Current and updated forecasts may not always be available while on extended patrols in the mountains. Having a basic understanding of mountain weather forecasting will allow you to use the weather to your advantage.

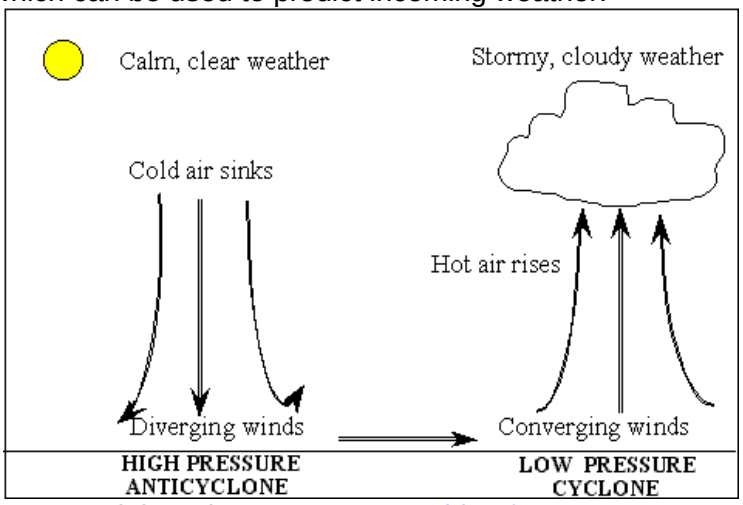
Weather Causes.

a. Sun. The sun warms the surface of the earth unevenly. The round shape and the tilt of the earth prevent uniform heating of the earth's surface.
b. Advection. Advection is the circular process of heated air at the equator expanding and rising up into the upper atmosphere. Cooler air at the Polar Regions condenses and sinks down to the earth's surface.
c. Coriolis effect. This is a complex phenomenon, which combines the rotation of the earth with the advection process. The Coriolis effect steers wind and pressure systems as they move from west to east in the Northern hemisphere and east to west in the Southern hemisphere.
d. Friction. The surface of the earth creates drag on weather systems and may influence the direction they take as well as where and how much precipitation comes from each system.
e. Moisture. The atmosphere is made up of 78% nitrogen, 21% oxygen, and 1% moisture. This 1% of moisture produces all precipitation.

Explain methods of measuring barometric pressure.

a. Barometric pressure. The pressure exerted by the atmosphere at any given place. The atmosphere acts like a liquid and therefore can be measured. The most common method of measurement is with the use of an altimeter/barometer.

(1) The altimeter/barometer is a calibrated device that measures the weight of a column of air from the surface of the earth to the top of the atmosphere. This method is used to determine elevation. Changes can occur in the readings as high or low pressure systems move through your area of operation. The common technique is to watch for changes in elevation readings when you are stationary. This will tell you the general trend in pressure change, which can be used to predict incoming weather.



High and Low Pressure Table of Contents

Identify and Understanding Cloud Types.

a. Cloud types. The height of a cloud and its' shape in the sky can indicate incoming weather up to about 36 hours out. Clouds can be right at the ground surface in the form of fog or up to a height of 6 miles.

(1) Low Level Clouds. Cloud types include nimbostratus and stratocumulus 0-6500ft. Low level clouds usually indicate impending precipitation. Precipitation from higher clouds evaporates before hitting the ground.

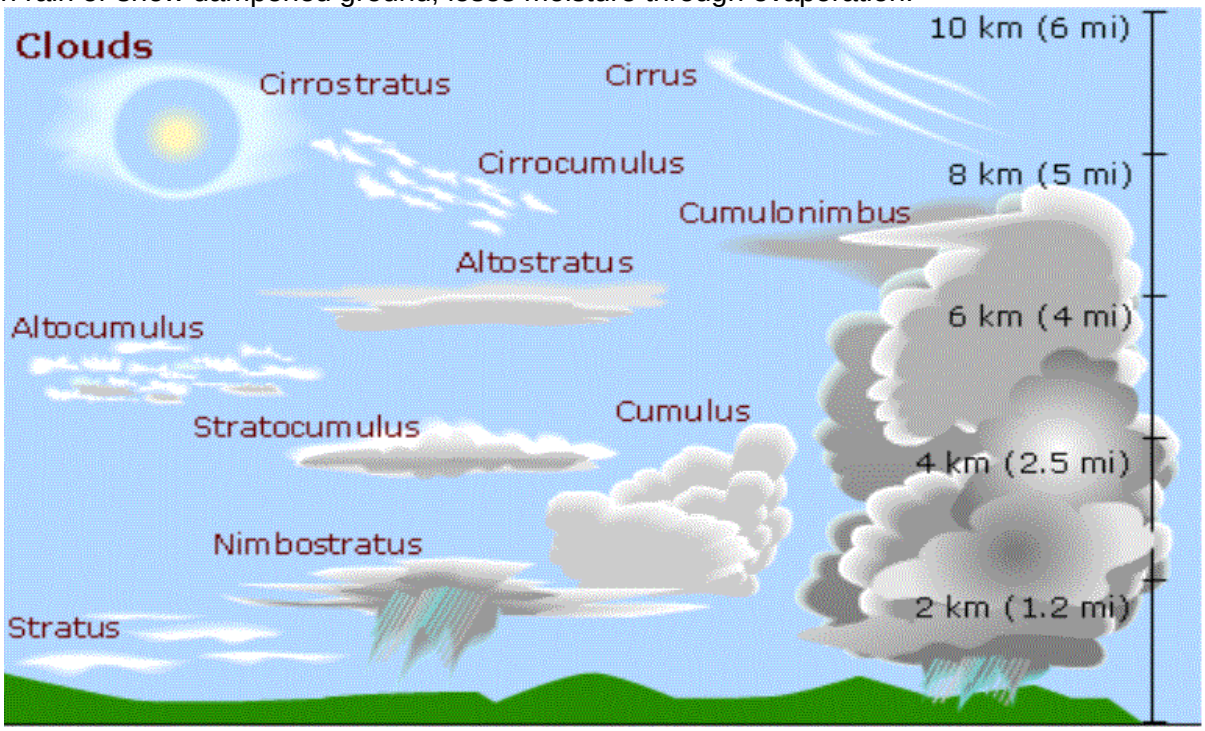
(2) Mid Level Clouds. Cloud types include Altocumulus and Altostratus 6500-20,000ft. Mid level clouds usually indicate fair weather, especially if they are rising over time. Lowering middle clouds indicate potential storms, though usually hours away.

(3) High Level Clouds. Cloud types include Cirrus and Cirrostratus 20,000ft +. Cirrus clouds indicate moisture aloft and the approach of a traveling storm system. Precipitation is often 24 to 36 hours away. As the storm approaches, these clouds will thicken, lower, and eventually become low-level clouds.

(4) Vertical Development Clouds. These include fair weather cumulus and Cumulonimbus clouds. Fair weather cumulus clouds have the appearance of floating cotton balls, but given suitable conditions can develop into towering Cumulonimbus clouds.

- Cumulonimbus clouds are often associated with powerful thunderstorms that can last for several hours.

(5) Other Cloud Types. Lenticular Clouds. Lenticular clouds can be associated with bad weather. Fog is caused when rain or snow dampened ground, loses moisture through evaporation.



Cloud Types

Identify the Types of Weather Fronts.

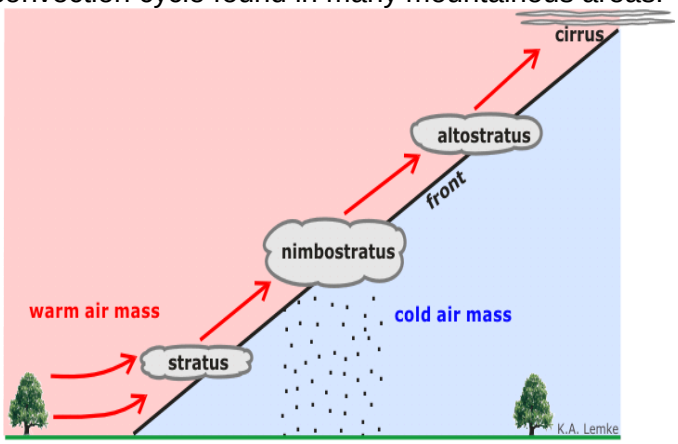
Fronts occur when two air masses of different moisture and temperature content meet. Understanding the differences between fronts will help your general planning and prediction.

a. Warm Fronts. Warm fronts are associated with low-pressure systems. Cirrus clouds indicate that a warm front is approaching. These clouds can be as far as 650 miles out in front of any precipitation. Contrails that linger and spread out in the sky and lenticular clouds that seem stationary over mountaintops are indicators of a low pressure or warm front moving in with in the next 24-48 hours. When high in the mountains, pay close

Table of Contents

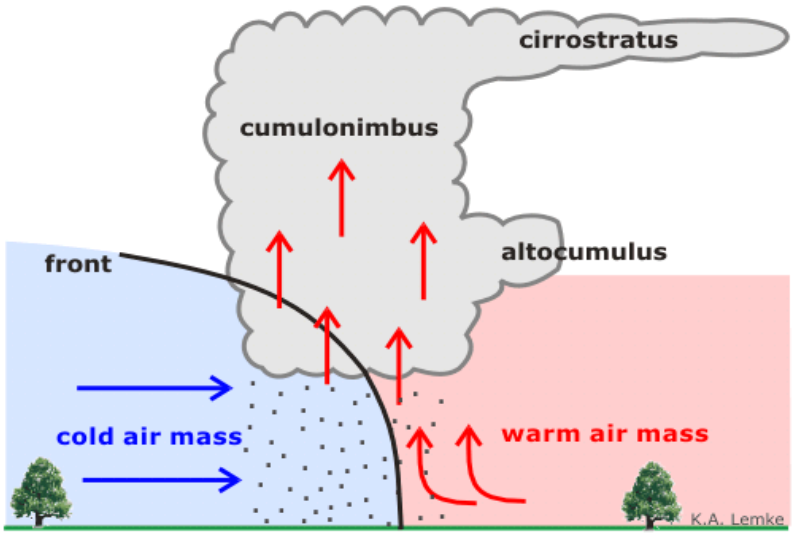
attention to the clouds. If you see them, building in height and getting lower to the ground you need to move to lower ground and off exposed ridges quickly. Move to the leeward side of a mountain to avoid the worst

aspects of a storm. If possible, get to the highest points of your climb early in the day to avoid afternoon storms caused by the daily summer convection cycle found in many mountainous areas.



Warm Front/ Low Pressure System

b. Cold Fronts. Cold fronts are associated with high-pressure systems and tend to move much faster than warm fronts. Summer time can bring violent thunderstorms or tornadoes due to the fast moving cold front colliding with the slower moving warm front it's replacing.



Cold Front/ High Pressure System

c. Valley Fog. Is another indicator of high pressure.
d. Occluded Front. An occluded front combines the precipitation of both warm and cold fronts. If it has rained for an extended period with occasional strong bursts of rain or snow, an occluded front is most likely the culprit. Occluded fronts for the most part are fast moving systems.
e. Stationary Fronts. As the name implies, these fronts are not going anywhere fast. Terrain can create stationary fronts. The Los Angeles basin is a good example of how the mountains that surround L.A. trap smog during a stationary front, only moving out when the stationary front is pushed out.

Table of Contents

Identify Weather Hazards and Safety Procedures.

a. Lightening.

b. Estimate storm distance.
c. Lightening Safety tips.
(1) Check the forecast and watch the sky.
Darkening skies, flashes of lightning, or increasing wind may indicate an approaching storm.
(2) Use the 30/30 Lightning Rule. If the time between the lightning flash and the rumble of thunder is 30 seconds or less (6 miles). Once inside shelter, you should not resume activities until 30 minutes after the last audible thunder. This is known as the 30/30 Lightning Rule.
(3) Count seconds between 'flash' and 'bang' and seek shelter when the time is less than 30 seconds.
(4) Find safe shelter.
Sturdy buildings are the safest place to be during lightning storms. Avoid sheds, open sided shelters, ditches, and isolated trees. Staying in a vehicle with windows closed also offers some protection.
(5) Avoid isolated trees or other tall objects. It is better to seek shelter under a thick growth of relatively small trees.
(6) Do not wait for rain to seek shelter.
(7) Avoid caves. Lightening can arc across the opening and follow the walls.
(8) Get out of the water. Water is a great conductor of electricity.
(9) Avoid any metal objects such as weapons, pickets or tools.
(10) Spread out and do not stay in a group
(11) Never lie flat on the ground during a lightning storm.
(12) If operating an open Gator or four wheeler and lightning is within 5 miles, STOP riding, get off, find a ditch or other low spot and sit down.
(13) Never lie flat on the ground during a lightning storm.
(14) As a last resort, assume the lightning-safe position

Note: If you are caught in a lightning storm and if you feel your hair stand on end, your skin tingle, or you hear crackling noises, crouch on the ground with your weight on the balls of the feet, your feet together, your head lowered and ears covered. Place your ruck and weapon several meters away. Some experts recommend placing your hands on your forehead and your elbows on your knees to create a path for lightning to travel to the ground through your extremities rather than through your core (heart).

d. Temperature. The temperature will drop 3-5 degrees F for every 1000 ft gained in elevation. Rapid cooling takes effect after the sun goes down due in part to the thinner atmosphere at higher elevations. Rock fall can occur when the sun thaws loose rock frozen during the night. Avalanches can be triggered with rapid warming of the snow pack. Cross danger areas early in the morning for the safest travel. Small streams crossed at night can become rushing torrents by midday when the sun-melted snow begins flow down from above.
e. Ultraviolet rays. 85% of UV rays are reflected back skyward on snow. Sunscreen with at least a SPF 15 rating is recommended. Sunburn can occur on the roof of your mouth, inside your nostrils, tops of your hands and anywhere else, unprotected skin is exposed. Snow blindness damage caused by UV rays can occur in minutes with the painful effects not being noticed for several hours after the exposure. Quality sunglasses rated for both UVA and UVB rays are highly recommended.
f. Wind. Many Mountains create their own weather. Wind speeds can gust over 100mph in narrow mountain passes. The sun can cause both up slope and down slope winds on the mountain through the heating and cooling of the atmosphere.
Table of Contents

Use an altimeter to estimate weather trends.

a. Confirm altimeter readings at known points on a map along the route. At long halts or in a bivouac site, record altimeter reading hourly.
b. In bivouac sites, lower elevation readings indicate high pressure moving in; conversely, higher readings indicate lower pressure. No changes in readings indicate a steady weather trend.
c. Most altimeter watches have a function that records the last six hours of barometric readings. Watch trends closely.

Identify the potential planning problems weather can cause.

a. The air temperature in the mountains drops an average of 4 degrees F for every 1000ft of elevation gained. The thinner atmosphere at higher altitude allows for more direct heat being received due to less atmospherics. In clear weather, temperature changes of 40-50 degrees can take place between day and night time conditions.
b. Flash floods can develop from storms miles away from where you are operating. Avoid wadis or other low depressions in flat terrain. Snowmelt can swell streams quickly. Plan to cross-streams early in the morning when possible.
c. Rock fall can occur where ice forms at night and thaws during the day.
d. Be prepared and trained to operate in whiteout conditions. In temperate climates, snow can occur anytime of year at elevations over 8000ft. changing weather may bring strong winds.
e. Troops need to be trained on how to wear the 7-layer system correctly to match the mission and environment.
f. Wind chill only affects living tissue. We feel the perceived temperature from the effects of wind and cold on exposed skin. The higher the wind speed, the faster we lose heat. Damage to exposed skin can occur in seconds under certain conditions.
g. Keep skin protected as much as possible. Use the buddy system to check each other out for signs of frostbite.
h. Learn to perform all job related functions with gloves on.

Table of Contents

Notes:

12 - Basic Mountain Casualty Evacuation

071E9018

Introduction: Conducting casualty evacuation in a mountainous environment can pose significant challenges due to terrain, elevation, weather and available equipment. Leaders must assess environmental conditions and enemy capabilities and plan/rehearse to ensure they are prepared to evacuate Soldiers. Although air evacuation may be available, an injured Soldier may need to be moved to an area where air can pick up the casualty. A unit's ability to quickly assess, treat and prepare to evacuate an injured Solider may be the difference between that Soldier's life and death.

Identify Phases of Tactical Combat Casualty Care.

a. Care Under Fire Phase

(1) Lasts only seconds (1-2 minutes max!)
(2) Scene safe/tactical situation. Don't become a casualty yourself.
(3) Check airway and blood sweep. Oral/Nasal adjuncts and tourniquets only (30 sec - 1 min)
(4) Arterial bleeding is #1 concern.
(5) Get casualty behind cover fast.

b. Tactical Field Care Phase

(1) 5, 10, 20 minutes… You have what you have. Make the most of it.
(2) Reduced hostile threat or behind good cover
(3) Rapid trauma assessment (3-5min)
(4) Head to toe, treat as you go. Patch him up quickly using the old ABCD.
(5) "Stay and play" or "load and go" decision

c. Combat Casualty Evacuation Phase

(1) No hostile threat
(2) Detailed trauma assessment (15 min)
(3) Head to toe, treat as you go, but in more detail. (Include neuro exams, etc…)

May be performed in place or on recovery asset.

Identify and Treat for Shock.

a. **Shock** = not enough oxygen to the cells.

(1) *Oxygen Delivery Requirements.* In order for the cardiovascular system to deliver oxygen to all cells of the body, there must be three functioning items:

(a) Pump (heart).
(b) Pipes (blood vessels).
(c) Oxygenated blood. If everything is functioning correctly, oxygenated blood is delivered to the cells. If anything interferes with this process, oxygen is not delivered to the cells where it is needed. The patient experiences this as "shock."

(2) *Types of Shock.*

(a) R respiratory: carbon monoxide poisoning, drowning, COPD, CHF, SIDS.
(b) N neurogenic: spinal damage, drugs, anaphylaxis, infection.
(c) C cardiogenic: heart attack, MI, angina pectoris.
(d) H hypovolemic: hemophage, burns, dehydration.
(e) A anaphylactic: bee stings, food reactions.
(f) M metabolic: diabetes.
(g) P psychogenic: fainting.
(h) S septic: systemic infection, TSS, toxemia of pregnancy.

(3) *Body's Compensation for Hypovolemic Shock.* The body will try to shunt blood to the vital organs (brain, heart and the lungs). Everything "non-essential" is shut down.Table of Contents

(4) *Signs and Symptoms of Shock.*

Class	Description
Class 1	Restlessness, anxiety, increased HR (heart rate)
Class 2	Cool clammy skin, increased R (respiration), increased systolic or decreased diastolic BP blood pressure), thirst, nausea/vomiting
Class 3	Pallor, cyanosis, decreased LOC, decreased BP
Class 4	Very low BP, carotid pulse only (if any), pupils fixed & dilated, comatose, death

(5) *The Golden Hour.* If a person is in severe shock (class 3) for one hour, they will die. After that "Golden Hour," death may come soon or in a few days.

(6) *Treatment of Shock.*
- (a) Treat the underlying condition
- (b) Lay the patient down
- (c) Elevate legs 18 inches (unless prevented by other injuries, i.e. hip fracture)
- (d) Maintain temperature
- (e) Reassure the patient
- (f) Oxygen
- (g) MAST
- (h) IV
- (i) Transport

Identify the Cause, Prevention and Treatment of Blisters.

a. **Causes.** Blisters are caused by friction that pulls the skin back and forth over underlying tissue. Eventually, a space develops and collects fluid. The most common cause is new or ill-fitting boots. Boots that are too loose in the instep allow the foot to slide forward when going downhill, producing "downhill blisters" on the front part of the foot. "Uphill blisters" are common over the heel and Achilles tendon.

b. **Prevention.** Wearing properly fitting boots, breaking in new boots slowly, protecting blister prone areas (hot spots) with adhesive tape or moleskin and minimizing friction between the foot and the boot, can avoid blisters. Friction can be reduced by keeping the foot dry with powder (to reduce adhesion between the boot and the skin). Wearing a thick outer and a thin inner sock (made of nylon or a similar material) will allow most of the slippage to take place between the two socks.

c. **Treatment.**

(1) If the blister will not receive any more pressure, protect the blister (pad around it) and allow the body to absorb the fluid.

Table of Contents

Unbroken Blister-Not Likely to Break

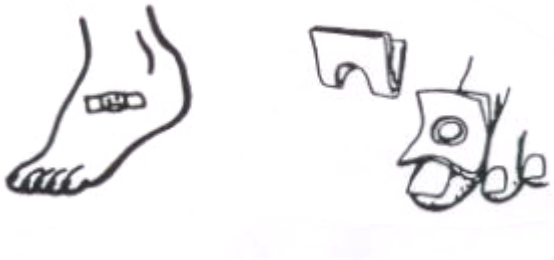
(2) If the blister is likely to break (i.e. during a road march), drain the blister and wash the area. Swab with povidone-iodine (check for allergy to iodine). With a sterile needle, make a hole at the bottom of the blister. With sterile gauze pad or clean cloth, apply pressure to drain the fluid. Often the blister will require draining several times during the first twenty-four hour period to allow the blister roof to adhere to the base. Tincture of benzoin around the blister will help the moleskin stick well. Cover the blister with gauze (so the roof is not torn off later). Apply a moleskin "doughnut". More than one moleskin layer may be necessary. Too much moleskin will cause problems.

Draining the Blister

(3) "Hot Shots", the practice of injecting tincture of benzoin compound into a blister, creates a much greater chance of infection and tissue damage. This procedure is not recommended.
e. Follow-up Care. See a medic if the blister gets worse or if there are any signs of infection (pus, redness). DO NOT perform self-care for blisters that lie deep in the skin.

Apply the Treatment for Broken Blisters.
a. **Treatment.** Treat a broken blister as an open wound: clean, dress and protect. Healing is faster, pain is diminished and the risk of infection is greatly reduced when the blister roof is preserved. If the roof is torn away, apply antibiotic ointment, cover with a non-adherent layer and protect with a moleskin "doughnut".
b. **Follow-up Care.** See a medic if the blister gets worse or if there are any signs of infection (pus, redness). DO NOT perform self-care for blisters that lie deep in the skin.

Table of Contents



Padding a Broken Blister

Identify the Principles of Rescue Operations.

a. **First Rule.** When faced with the necessity of rescuing a casualty threatened by hostile action, fire, water or any other immediate hazard, do not take action without first determining the extent of the hazard and your ability to handle the situation. The first rule of rescue is "DO NOT BECOME A CASUALTY".
b. **Primary Mission.** The primary mission is to get the casualty to appropriate medical care without causing further injury.
c. **Three Major Steps.** The rescuer must evaluate the situation and analyze the factors involved. This evaluation can be broken down into three major steps:

(1) *Identify the Task.* Decide if you really need a rescue attempt. It is a waste of time, equipment and personnel to rescue someone not in need of rescuing, to look for someone who is not lost or risk the lives of the rescuer(s) needlessly. In task identification, attempt to obtain the following information:

(a) Who, what, where, when, why and how the situation happened?
(b) How many casualties are involved and the nature of their injuries?
(c) What is the location of the casualties?

(2) *Evaluate the Circumstances of the Rescue.* After identifying the task required, you must relate it to the circumstances under which you must work.

(a) Do you need additional people, security, medical or special rescue equipment / skills?
(b) What is the tactical situation?
(c) What are the weather conditions?

- When considering weather, you should insure that blankets or rain gear are available. Even a mild rain can complicate a simple rescue. Available time diminishes with high altitude and/or in extreme cold and gusting winds.
- High altitudes and gusting winds reduce the ability of aircraft to help in operations. Rotary wing aircraft may be available to remove casualties from cliffs or inaccessible sites and transport to medical treatment facilities in a comparatively short time.

(d) Is the terrain hazardous? With respect to terrain, you must consider altitude and visibility. Uses of secure /reliable trails or roads are essential.
(e) Aircraft are vital elements of search and rescue units. You cannot use aircraft in all rescue situations. Do not rely on their availability. Reliance on aircraft or specialized equipment is a poor substitute for careful planning.

(3) *Plan the Action.*

(a) The time available can cause rescuers to alter their rescue/treatment plans. Make a realistic estimate of time available as quickly as possible.
(b) Timely gathering of accurate information, so that an effective assessment of the situation can be made, is essential. Once the initial investigation is complete, outline a list of options with backup contingencies for optimum flexibility. Establish goals and objectives for the first working periods of the mission. Apply basic principles of emergency response during this phase.

Identify Considerations for Evacuating a Casualty.

a. **General Considerations for Evacuations.**

(1) Select the smoothest available route.
(2) Avoid unnecessary handling of the patient.
(3) Protect the patient from all environmental hazards (i.e. falling rock) by placing, his helmet over his head and pad him in the litter.
(4) When the evacuation route is long and difficult, a series of litter relay points or warming stations should be established. Staff these warming stations with the minimum medical personnel needed to allow proper emergency treatment. Hold any patient that develops signs of shock during evacuation at warming station/relay point. Treat and stabilize before continuing the evacuation.
(5) You can use skis to form expedient litters and as a substitute for the ahkio sled.

Table of Contents

(6) Use helicopters or heated vehicles for evacuation whenever the situation, terrain and weather permit.
(7) Augment litter teams in rough terrain.
(8) Movement of a casualty over technical routes can be easier than movement through brush and rough terrain.

b. **Special Training Requirements.**

(1) Before receiving training in basic mountain evacuation, litter teams should receive instruction in military mountaineering.
(2) Litter bearers and aid men must become thoroughly familiar with rope and mountaineering equipment.
(3) The members of litter teams must become thoroughly proficient in the technique of belaying and in the selection of belay points so that proper support and protection can be given to patients and litter bearers when evacuating over difficult terrain.

c. **Handling Wounded Soldiers.** You may save a wounded Soldier's life through the application of the appropriate first aid measures only to lose him through careless or rough handling during transport. Before you attempt to move the wounded Soldier, you must evaluate the type and extent of his injury. Reinforce dressings over wounds. Immobilize and support fractured bones to prevent causing more damage.

Note: It is important to establish proper safety measures for both the casualty and the rescue personnel.

Identify Patient Packaging Considerations.

a. **Patient Packaging Considerations.**

(1) Injury
(2) Distance of travel
(3) Terrain
(4) Weather
(5) Number of rescue personnel
(6) Time
(7) Equipment available

b. **Principles of Patient Packaging.**

(1) Patient immobilization
(2) Insulation or ventilation
(3) Padding
(4) Vapor barrier
(5) BUFF (Big, Ugly, Fat, Fluffy)
(6) Do no further harm

c. **Types and Characteristics of Manufactured Litters.** Personnel involved with mountain evacuation will encounter several litter types. The most common are the following:

(1) **Poleless, non-rigid litter.** The non-rigid, nylon litter is the least favored. It does not offer much protection for injuries. There is also a substantial amount of difficult rope and knot work involved.
(2) **Standard collapsible litter.** The standard collapsible litter is the most common in the military system. It also involves substantial knot and rope work.
(3) **Stokes/Mountain basket-type rigid litter.** The use of the rigid Stokes litter serves to eliminate much of the rope work used in the two previous litter types.
(4) **SKED stretcher.** The SKED stretcher is quickly replacing all of the above litters in the military system.

Table of Contents

d. **Preparing the SKED for Low Angle Evacuation.**

(1) Tie a double figure eight in the middle of a 30-foot long 11mm rope. Pass each end of the rope through grommets at head of stretcher. Leave 1-2 feet between the knot and the stretcher. Continue feeding rope through the grommets and handles all the way to the end. Tie the ends of the rope together with a square knot. Bring the ends of the rope up over the ends of the SKED and through the carrying handles. Tie another square knot with overhand safeties.

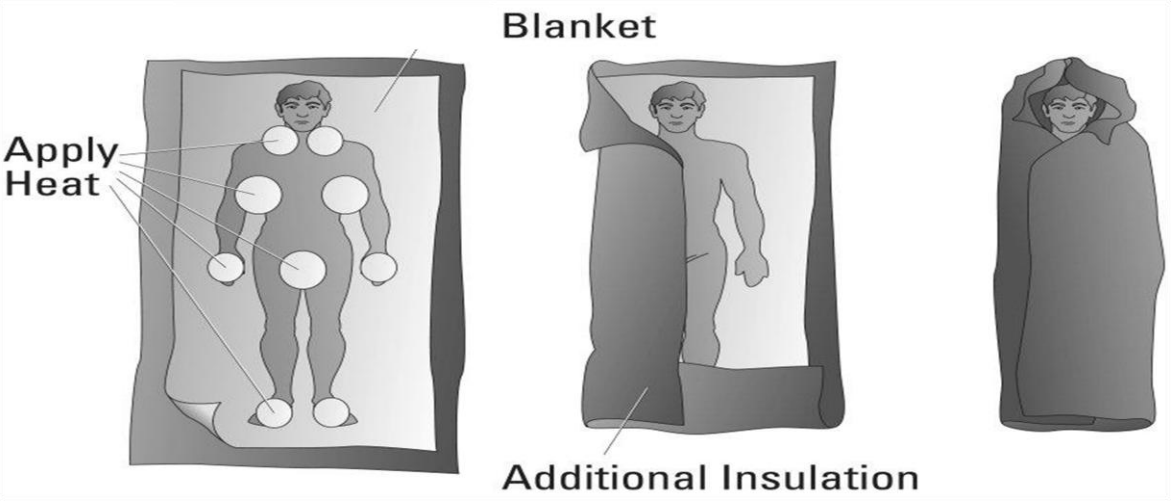
(2) Tie a double figure eight at one end of a sling rope and a single figure eight at the other end. Repeat with another sling rope. The litter bearers attach themselves to these ropes with an auto block attached to their harness.

(3) If hypothermia is a threat, use a hypothermia wrap.

(a) **Hypothermia Wrap.**

- Place a poncho in the bottom of the litter.
- Place a sleeping mat and then a sleeping bag on top of the poncho.
- Once the patient is in, place another sleeping bag and poncho on top.
- This forms a warm, water-resistant cocoon for the patient.

(4) Cervical padding should be placed around the head and neck using improvised items such as boots, rolled up shirts, rolled up blankets, etc.



Identify Techniques Used to Ascend and Descend Slopes and Cliffs.

a. **Ascending a Slope with a Litter.**

(1) Main Force.

(a) To ascend a moderately steep slope that can be walked, litter bearers take their places.

(b) Any extra bearers take their positions along the extended rope that is in the hands of the belay man.

(c) Exchange positions at each halt. Upon arrival at each belay point, place the litter on the ground and take a new position farther up the slope.

(2) *With a hauling system.* Upon encountering small steep obstacles, main force is sometimes not adequate for the task. In these situations, use a hauling system to assist the litter bearers.

b. Descending Slopes with a Litter.

(1) One man acts as the belay man while another assists him. The litter bearers take their positions. Use a munter hitch or a super munter, depending on the slope.

(2) Other personnel may help with the litter or precede the team. If preceding the team, they can make reconnaissance, clear a trail or establish successive belay points.

(3) Take the most direct practical path. Use available trees and rocks as belay positions.

(4) Be sure to keep the casualty's head uphill with his helmet on. Table of Contents

c. Traversing Slopes with a Litter. If the evacuation route includes traverses, use directional anchors to prevent the litter team from taking a "pendulum" fall.

d. Belay Method.

(1) The installation rope will be tied off to an appropriate anchor.
(2) A hot point tied into the installation rope; clip a locking carabiner and a locking parabiner into the hotpoint.
(3) Tie a munter hitch with the load rope into the parabiner.
(4) Tie a three wrap prusik on the load rope approximately 18 inches away from the munter hitch, tying the prisik off with a munter mule into the locking parabiner. (see figure 1)
(5)This brake system is for lowering a load only
(6)The rope must run over the solid portion of the parabiner, away from the gate. If the rope touches the gate, it could unlock and open the parabiner.
(7) To operate the brake pull the ropes back against the parabiner.

Figure 1

Table of Contents

(8) The installation rope, the hot point of the Sked and the attendant line will be clipped into 2 opposite and opposed carabiners. (see Fig 2)

Figure 2

(9) The attendant can be secured to the attendant line with a locking carabiner into his harness, a figure 8 clipped into the locking carabiner with an autoblock tied onto the attendant line so he can go hands free if needed.(see figure 3)

Table of Contents

Figure 3

Notes:

13 - Altimeter Land Navigation

071E9012

INTRODUCTION: The altimeter/barometer is an extremely useful tool for mountain navigation. It provides the Soldier an ability to determine altitude, interpret the weather, pinpoint an exact location, check movement progress and identify terrain features. A Soldier's proficiency with an altimeter greatly enhances a unit's ability to navigate in the mountains.

Define the Altimeter/Barometer.

a. Altimeter / Barometer. The Altimeter/Barometer can provide readings of elevation above and below sea level and barometric air pressure in inches of mercury or millibars. The altimeter reads in feet or meters. Many versions exist.

Identify the uses of the altimeter/barometer.

An altimeter will aid you in the following:

(1) Locate your position.
(2) Route planning.
(3) Monitor your rate of ascent or descent.
(4) Interpret the weather in your location and monitor changing weather fronts.

Identify altimeter specifications.

The following list includes general specifications of an altimeter.

(1) Range. The range is the lowest reading possible (usually below sea level) to the highest reading possible (usually up to 30,000 feet).

(2) Accuracy. Different altimeters will sense elevation change at varying accuracy and from +/- 10 feet to +/- 30 feet.

(3) Scale Units. Either the altitude scale can be in feet or meters or the barometric pressure scale can be in inches of mercury (Hg) or millibars (mB).

(4) Field Display. The altitude will be displayed in either a digital or an analog format depending on the device.

NOTE: There are many different types of altimeters available. Check with the manufacturer for your device's specifications.

Measure the altitude differences using the altimeter.

a. **Use the altimeter to measure difference in elevation during movement.**

(1) Set your altimeter to a certain elevation.
(2) Climb or descend to another elevation.
(3) Re-check your altimeter.
(4) The difference between your first reading and the second reading is the number of feet gained or lost in elevation.

(a) Examples of using altitude differences;

- At the start of a foot march, your altimeter indicates 2000 feet. Now you read 2480 feet. You have climbed 480 feet (2480 feet – 2000 feet = 480 feet).
- If it has taken you 2 ½ hours to gain the first 1500 feet of a 3000-foot climb and you know that the trail will continue at the same roughness and grade, you will not be far off in estimating your arrival at the peak about five hours after you start. It is advised to add time for longer rest stops.

b. **Rate of ascent/descent.** Sometimes it helps to decide whether to continue to climb or to turn back, by checking the rate of ascent. For example, during a climb you have been keeping an hourly check on time and elevation. It has taken your team 4 hours to climb 3,000 feet, an average of 750 feet per hour, but the actual rate of ascent has been declining with each hour. Table of Contents

In fact, the team gained only 500 feet in the past hour, compared with 1,000 feet the first hour. Your destination is at an elevation of 8,400 feet, and an altimeter reading shows the team is now at 6,400 feet. Therefore, you can predict that it will take at least four more hours to get to your destination. Take your rate of ascent and combine it with the weather, time of day, condition of the team. This will give you the data on which to base a sound decision on whether to proceed or turn back.

Measure the elevation readings above sea level using the altimeter.

a. **Measuring and using elevation above sea level.**

(1) *Adjust.* Adjust your altimeter/barometer to show true height above sea level using supplied altimeter instructions.

(2) *Starting Point.* Set the altimeter accurately at your start point. As you gain or lose elevation, the height indicated will be your elevation above sea level.

(3) *Resetting.* This is an important technique for maintaining accurate altimeter readings. Regularly reset your altimeter at points of known elevation, because its accuracy depends on the weather.

(a) A change in weather is accompanied by a change in air pressure, which can cause an error in the altimeter reading. As one rises, the other drops and vise versa.

(b) A change in barometric pressure of 1 inch or mercury corresponds to a change in altitude reading of roughly 1,000feet.

For example, if overnight the air pressure decreased by 0.2 inch (7 millibars), the altimeter could show a reading of about 200 feet more than it did the previous night, even though the actual elevation has remained the same. Even during apparently stable conditions, an error in elevation reading of 100 feet per day is not uncommon.

(c) When you are following your progress on a topographic map, you can read the height of any point you can identity by looking at the contour lines and there should be many opportunities to reset your altimeter.

(4) *Use.* Using the altimeter, you can relate readings to elevations of contour lines on the map to verify your progress on your planned route.

(5) *Resection.* Many Soldiers rely on resection to fix their position. In the woods or at night it is often impossible to get two bearings on two identifiable points. With an altimeter recently reset, you can get the same results using modified resection.

Example: You are moving through the woods or traveling on a trail shown on the map. Through the trees, you spot the fire tower on a nearby mountain. Your compass gives a bearing of 30 degrees. Your altimeter reads 4000 feet. You must be on the contour line that indicates 4000 feet elevation. Simultaneously you have the fire tower on the back azimuth of 30 degrees (210 degrees). Draw the back azimuth or place the compass on the map so one edge of its' base plate points at the fire tower. In this example, you crossed a contour line with another position line on the map. You can probably think of many such lines; trails, creeks, compass bearings, roadways, marked game management boundaries and power lines. One rule always applies; you fix your position most accurately with two position lines that cross at right angles.

b. **Route Planning**. The knowledge of your elevation above sea level, gained from your altimeter, can also help you in route planning. For example, a Soldier needs to return to a cache at the 3600-foot level. Instead of entering the woods at the foot of the mountain and walking uphill to reach 3600 ft, he can enter the woods at the 3600-foot level of the road that he is on and find a level route to his cache.

Interpret weather using the altimeter/barometer.

a. **Reading the Altimeter.**

(1) You can make use of your altimeter/barometer as a highly accurate weather barometer by following these procedures.

(a) Stationary. Check you are altitude reading. If the barometric pressure changes so, will your altitude reading.

Example: You initially have a reading of 2500 ft. Four hours later, you have a reading of 2000 ft. Since the reading is now 500 ft lower and you did not move, you can assume that fair weather is expected.

(b) Underway. If you find it necessary to readjust the altitude at known point then you can assume that the barometric pressure is changing. Example: At known points you keep having to decrease your altimeter reading to match the altitude of your known point. Since the altitude continues to read high, you can assume that foul weather is expected.

b. **Applying the altimeter reading to general weather forecasting.**

(1) If you have a situation where the air pressure is rising, it suggests that fair weather is expected.

(2) If you have a situation where the air pressure is falling, it suggests that foul weather is expected.

Identify the differences between an altimeter and a GPS.

a. The altimeter determines elevation by measuring the weight of a column of air (air pressure) either electronically or mechanically. A GPS determines elevation through the triangulation of four or more satellites.

b. A GPS requires four satellites at a minimum for an accurate elevation reading. Mountainous terrain, poor weather, and thick overhead cover can mask satellite signals preventing a good reading.

c. The fact that GPS uses triangulation of satellites to measure elevation, not air pressure, means that they have no use as a weather prediction tool. Changing air pressure is the key for weather prediction.

NOTE: Care should be taken when using GPS to pinpoint exact elevations. Mathematical variations in the software of some types of GPS devises can produce variation of 100 to 200 foot discrepancy in elevation. The horizontal accuracy is not necessarily equal to the vertical (elevation) accuracy

Table of Contents

NOTES:

14 - Avalanche Awareness and Rescue
071E9034

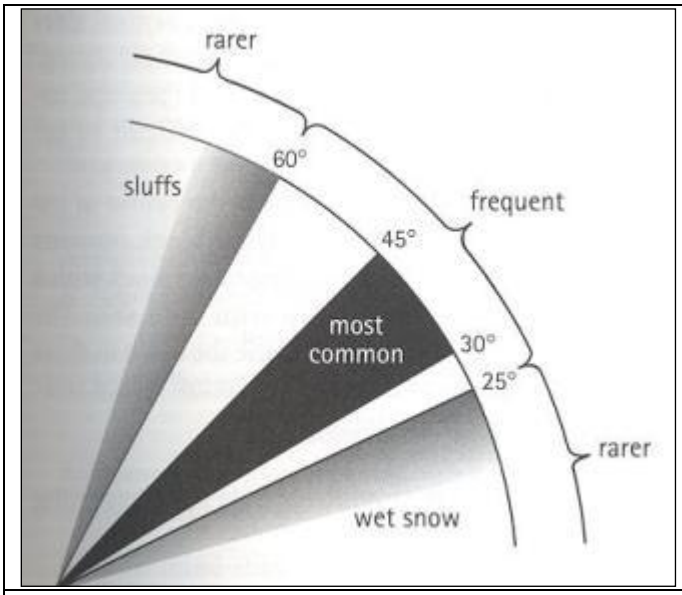
INTRODUCTION: Soldiers operating in mountainous terrain must have a basic knowledge of avalanches and how to avoid them. The ability to identify avalanche areas, identify types of weather causing avalanches and understand actions to take if Soldiers are caught in one is extremely important for units operating in snow covered mountainous terrain.

Identify the Factors Leading to Snow Avalanches.

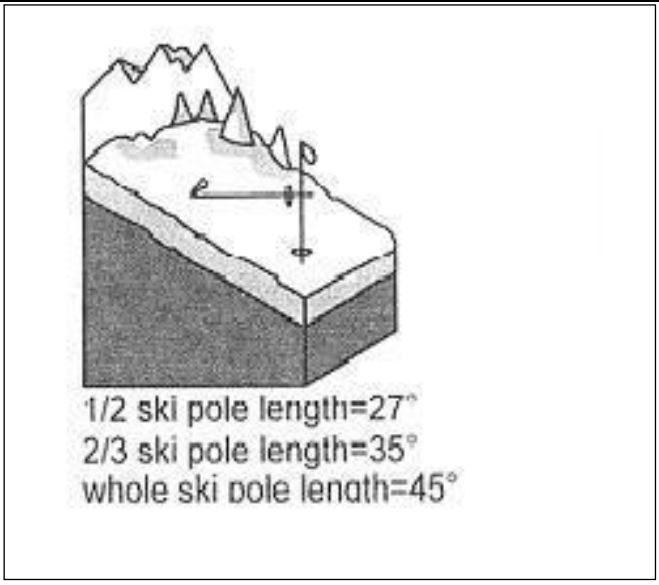
a. **Occurrence.** Avalanches occur when the weight of accumulated snow on a slope exceeds the cohesive forces that hold the snow in place. This usually requires elements of the four main factors: terrain, weather, snow and humans.

b. **Terrain Factors.**

(1) *Slope Angle.* Slopes as gentle as 15^{o} have avalanched. Most avalanches occur on slopes between 30^{o} and 45^{o}. Slopes above 60^{o} often do not build up significant quantities of snow because they are too steep. As with most rules, there may be exceptions. Evaluate any slope above 30^{o} for stability before movement. Use an inclinometer to estimate the slope angle. Construct a field expedient inclinometer from two equal length ski poles. Mark one pole at the exact center. Join the unmarked pole to the midpoint of the marked pole at a 90^{o} angle. Place the tip of the marked pole on the slope. If the tip of the unmarked pole touches the slope, the angle is approximately 30 degrees.



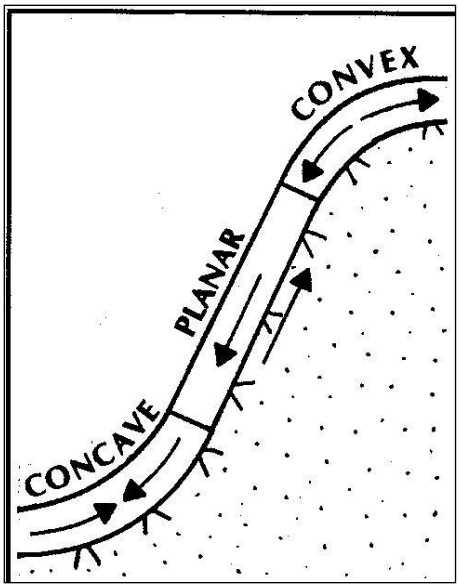
Slope Angle



Field Expedient Slope Profile

(2) *Slope Profile.* Dangerous slab avalanches are more likely to occur on convex slopes, but may occur on concave slopes. The trigger for an avalanche on a concave slope may come from the flat ground below the slope.

Table of Contents



Slope Profile

(3) *Slope Aspect.* Snow on north facing slopes is more likely to slide in midwinter. South facing slopes are most dangerous in the spring and on sunny, warm days. Slopes on the windward side are generally more stable than leeward slopes. Leeward slopes tend to form dangerous cornice formations.

(4) *Ground Cover.* Rough terrain is more stable than smooth terrain. On grassy slopes or scree, the snow pack has little to anchor to. Boulders and trees act as anchors to help hold the snow in place.

c. **Weather Factors.**

(1) *Temperature.* When the temperature is very low, settlement and adhesion occur slowly. Avalanches that occur during extreme cold weather usually occur during or immediately following a storm. At a temperature just below freezing, the snow pack stabilizes quickly. At temperatures above freezing, especially if temperatures rise quickly, the potential for avalanche is high. Storms with an accompanying rise in temperature can deposit dry snow early, which bonds poorly with the heavier snow deposited later. This creates an unstable snowpack. Most avalanches occur during the warmer midday. Due to temperature fluctuations.

(2) *Precipitation.* About 90 percent of avalanches occur during or within twenty-four hours after a snowstorm. The rate at which snow falls is important. High rates of snowfall, 1 inch or greater, especially when accompanied by wind, are usually responsible for major periods of avalanche activity. Rain falling on snow will increase its weight and weakens the snowpack.

(3) *Wind.* Sustained winds of 15 mph and over transport snow from the windward aspect of the slope and forms wind slabs on the lee slopes.

d. **Snow Factors.**

(1) *Unstable Snow Layers.*

(a) New snow greater than 1 foot.
(b) Crusty, wind packed or iced layer next to soft snow.
(c) Loose, cold snow.
(d) Buried surface hoar.
(e) Depth hoar occurs deep in the snow pack and may act like ball bearings.
(f) Hollow spaces.
(g) Settled snow under a crust or water runoff above a crust.

e. **Human Factors**.

(1) *Weight/Overloading.* Most victims trigger the avalanches that kill them.

(2) *Vibration.* Passing helicopters, heavy equipment and explosions have triggered avalanches

Table of Contents

Identify the Types of Snow Avalanches.

a. **Types of Snow Avalanches**. There are two types of snow avalanches: loose snow (point) and slab.

(1) *Loose Snow.* Loose-snow avalanches start at one point on the snow cover and grow in the shape of an inverted V. Occurrences:

(a) Dry Loose-snow avalanches occur at all times of the year in the mountains. They happen most frequently during the winter snow season. They often fall as many small sluffs during or shortly after a storm. This process removes snow from steep upper slopes and either stabilizes lower slopes or loads them with additional snow.

(b) Wet loose-snow avalanches occur in spring and summer in all mountain ranges. Large avalanches of this type, lubricated and weighed down by melt water or rain, can travel long distances and have tremendous destructive power. Coastal ranges that have high temperatures and frequent rain are the most common areas for this type of avalanche.

(2) *Slab Avalanches.* Slab avalanches occur when cohesive snow begins to slide on a weak layer. The fracture line where the moving snow breaks away from the snow pack makes this type of avalanche easy to identify. Slab release is very rapid. Although any avalanche can kill you, slab avalanches are considered more dangerous than loose snow avalanches. Occurrences:

(a) During or shortly after a storm when slopes are loaded with new snow at a critical rate. The old rule of never travel in avalanche terrain for a few days after a storm still holds true.

(b) Most victims trigger the avalanche that kills them. As slabs become harder, their behavior becomes more unpredictable; they may allow several people to ski across before releasing. Many experts believe they are susceptible to rapid temperature changes. Packed snow expands and contracts with temperature changes. For normal density, settled snow, a drop in temperature of 18 F would cause a snow slope 300m wide to contract 1 inch. Early ski mountaineers in the Alps noticed that avalanches sometimes occurred when shadows struck a previously sun-warmed slope.

(c) At higher elevations, because of different weather conditions, instability can persist for many days. Slabs release between storms without warning.

(d) Formation. Soft slabs form over widespread areas during heavy storms, are associated with moderate wind speeds, high humidity, and rimed snow crystals. Hard slabs tend to form on lee slopes. It usually requires low temperatures and wind blown snow. Frequently, hard slabs form over a weak layer of depth hoar, which fails to support the slab. This accounts for the characteristic hollow feeling and the drop of a few centimeters when the slab fails.

Perform Snow Pit Analysis.

a. **Snow Pits.**

(1) Dig a 2m x 2m pit across the fall line, 4-5 feet deep (or deep enough to get to the likely bed surface). Dig the snow pit on the suspect slope (this should be done while on belay incase the slope avalanches) or a slope with the same sun, angle, elevation and wind conditions. Snow deposits may vary greatly within a few meters due to wind and sun variations. (On at least one occasion a snow pit dug across the fall line triggered the suspect slope). Once the pit is complete, smooth a side with a shovel and examine the layers.

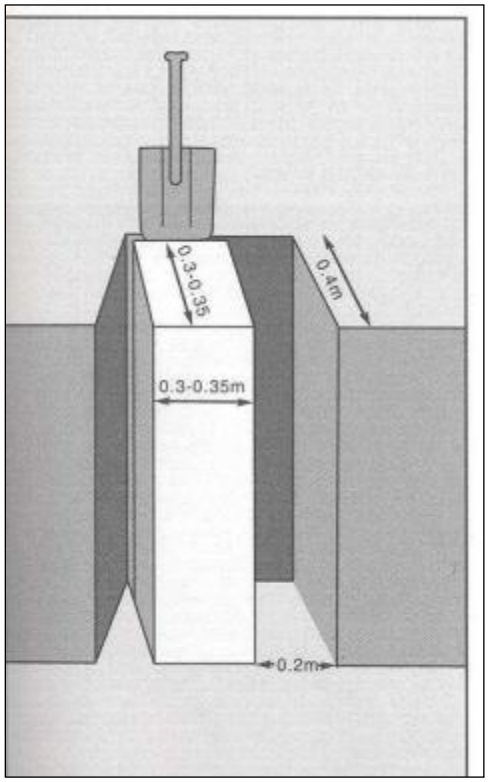
(a) Lightly flicking a woolen glove across the snow face, or better still, brushing with a paintbrush will etch out the hard and soft layers. You may find many layers that reflect minor variations in wind, temperature or humidity. You are only concerned with layers that are unusually hard and unusually soft.

(b) In conditions close to 32 degrees F, find the temperature of the snow. You are looking for snow that is within a degree or two of the freezing point. This layer might slide as a wet snow avalanche. Look for clusters of large, wet, non-cohesive ice grains. Water seeping through the snow pack and freezing in the colder layers underneath cause ice lenses. Their presence does not necessarily mean the snow pack is in a weak condition. The chance of wet snow avalanching does increase as the temperature of the snow around the ice approaches 32 degrees F.

(2) After examining the layers, do a shovel shear or sliding wedge test. Use the same spot that the data pit was dug. Dig out the data pit with the shovel and then isolate the column with the saw or cord. Place a

Table of Contents

shovel behind the column and pull with equal force to see where the weak layer is. Insert a ski pole about one meter up the fall line from the snow pit and centered. Use a length of avalanche cord about two meters long. Pass it around the uphill side of the ski pole, to form an equal sided triangle (including the snow pit as the base), saw down through the snow pack.



Snowpit

Identify the Deliberate Triggering of Avalanches.

a. **Deliberate Triggering of Avalanches.** Having the experience and knowledge of what causes avalanches and how to avoid them can also is applied to the deliberate triggering of avalanches. The ability to use the terrain to your advantage acts as a force multiplier and combat enhancer.

(1) *Use.*

(a) Force Protection. A thorough map recon and terrain analysis prior to the mission will identify potential avalanche slopes. To prevent friendly troops from avalanche danger, these slopes could be triggered ahead of the main body by various techniques if the tactical situation permits. Look for slope profile and slope angle.

(b) Denying the Enemy Key Terrain. Mountainous terrain is characterized by fewer avenues of approach (especially for vehicles) and steep narrow passages. Triggering avalanches can slow down or deny the enemy access through steep mountain passes. In WWII, the Norwegians severely limited the Germans movements through the Norwegian mountains by deliberately setting off avalanches.

(c) Offensive Operations. Enemy elements can be ambushed and/or isolated by deliberately triggering avalanches. This technique was successfully used against the Soviets in Afghanistan. Once the Soviet elements were isolated and trapped, much smaller forces easily destroyed them.

(2) *Principles.*

(a) Location. Understanding what can cause an avalanche and where they are likely to occur, you can best select the location to trigger it. Choose a point of maximum tension in the snow pack to detonate the charge. Maximum effectiveness is achieved with a detonation about 1 m above the snow pack.

Table of Contents

The next best option is on the surface of the snow pack and the least effective is in the snow pack. Placing charges on cornices above avalanche prone slopes can be very effective. The fragmentation effect of placing near rocks or boulders can also multiply the effect.

(b) Triggering. The best technique for triggering an avalanche will depend on many factors. The best technique is the one that delivers enough detonation force as accurately as possible.

- Anti-tank/Recoilless Weapons.
  - Advantages. Very accurate.
  - Disadvantages. Limited range. Accuracy depends on clearly seeing the target.
- Mortars.
  - Advantages. Deliver a large amount of explosives to the target. Rounds can also be airburst for maximum effectiveness.
  - Disadvantages. High winds can affect accuracy due to its high trajectory.
- Artillery.
  - Advantages. Ideal due to its long range. Ability to deliver massive amount of explosives. Capability of airburst rounds.
  - Disadvantages. Requires skilled FO to get to an area where he can observe.
- Improvised Explosives. Small charges of C4 (1-2kg) with a time fuse are very effective if placed correctly.
  - Advantage. Very effective, accurate and can be done from the top of the slope.
  - Disadvantage. Smaller charge requires an accurate placement.
- Hand Grenades. Fragmentary or concussion grenades would be used similar to improvised charges.
  - Advantage. Effective for areas where indirect fire is inappropriate.
  - Disadvantage. May require exposing the Soldier employing the grenade to a greater risk than indirect fire techniques.

(c) Time. The best times are during or immediately after a heavy snowfall, during the heat of the day or when the slope is exposed to the sun or after a rain or thaw.

Reduce the Risk of Avalanche.

a. **Protective Measures.**

(1) *Avoidance.* Avoiding known or suspected avalanche areas is the easiest method of protection.

(2) *Stabilization.* Triggering the suspect avalanche slope before movement usually will stabilize it. Suspect slopes are sometimes shot at with artillery or detonated with explosives. Belayed skiers are often used after the explosives.

(3) *Barriers.* Barriers similar to tank obstructions are often placed in avalanche prone areas to anchor snow to the slope.

(4) *Personal Safety.* Remove your hands from ski pole wrist straps. Release rucksack waist and chest straps. Detach ski runaway cords. Prepare to discard equipment. Put your hood on. Close up your clothing. Prepare for hypothermia. Turn on avalanche transceivers. Deploy avalanche cord. Make avalanche probes and shovels accessible.

(5) *Group Safety.* Send one person across at a time, with the rest of the group watching. All ski in the same track.

b. **Route Selection.**

(1) Always allow a wide margin of safety when making your decision. The safest routes are on ridge tops, slightly on the windward side; the next safest route is out in the valley, far from the bottom of slopes.

(2) Avoid cornices from above or below. Should you encounter a dangerous slope, either climb to the top of the slope or descend to the bottom. Well out of the way of the run-out zone. If you must traverse, pick a line when you can traverse downhill as quickly as possible. When you must ascend a dangerous slope, climb to the side of the avalanche path and not directly up the center.

Table of Contents

(3) Take advantage of dense timber, ridges or rocky outcrops as islands of safety. Use them for rest stops. Spend as little time as possible on open slopes.

(4) Since most avalanches occur within twenty-four hours of a storm and/or at midday, avoid moving during these periods. Moving at night is tactically sound and may be safer.

c. **Stability Analysis**. Look for nature's billboards on similar slopes and the one you are on.

(1) *Evidence of Avalanching.* Look for recent avalanches on similar slopes.

(2) *Look for signs of wind loading or wind-slabs.*

(3) *Fracture Lines.* Avoid any slopes showing cracks.

(4) *Sounds.* Beware of hollow sounds (a "whumphing" noise). They may suggest a radical settling of the snow pack. "People trigger avalanches that bury people. If these people would recognize the hazard and choose a different route, they could avoid the avalanche."

React to an Avalanche.

a. **Survival.** If caught, you must fight for your life.

(1) *Discard Equipment.* Equipment can injure or burden you. Discarded equipment will be an indicator as to your position.

(2) *Stay on Top*. Swim or roll to stay on top of the snow. Work toward the edge of the avalanche. If you feel your feet touch the ground, give a hard push and try to pop out onto the surface.

(3) *Going Under*. As your head goes under the snow, shut your mouth, hold your breath and position your hands and arms to form an air pocket in front of your face. Many avalanche victims suffocate by having their mouths and noses plugged with snow.

(4) *Beneath the Surface*. When you sense the slowing of the avalanche, you must try your hardest to reach the surface. Several victims have been found quickly because a hand or foot was sticking above the surface.

(5) *Stopping.*

(a) The snow sets up like cement, and even if you are only partially buried, it may be impossible to dig yourself out. Do not shout unless you hear rescuers immediately above you. In snow, no one can hear you scream.

(b) Don't struggle to free yourself. You will only waste energy and oxygen.

(c) Try to relax. If you feel yourself about to pass out, do not fight it. The respirations of an unconscious person are shallower, their pulse rate declines and the body temperature are lowered, all of which reduce the amount of oxygen needed.

b. **Search Analysis.**

(1) *Analysis.* Analysis of the avalanche path can reveal the location of a victim. There are three zones to consider.

(a) Starting Zone. Victims are not usually found in the starting zone. A victim's position in the starting zone will have a bearing on his final location. If you see a fellow Soldier is caught, watch him to give you a clue to where to start searching.

(b) Avalanche Path. The snow along the edge of the path will move slower than the center. If the path curves, the snow traveling the longer radius will move slower than the shorter radius. Slower snow areas in the area directly above an obstruction and all areas of heavy snow deposit are likely places to find a victim.

(c) Run-out Zone. This is where the avalanche slows and stops. This is where the largest deposits of snow are found and is most likely to hold victims.

(2) *Probable Location.* To plot a victim's most probable location, you must consider several things:

(a) Point Last Seen (PLS).

(b) Equipment Clues.

(c) If you have the PLS, the avalanche path and clues you can draw a line to figure out the victim's probable path.

Table of Contents

c. **The Avalanche Transceiver.**

(1) *Transceiver.* The operating frequency is the world wide standard of 457 kHz. There are many different types of transceivers. Most operate with an audio mode and visual display. Check transceivers individual specifications.

(2) *Function Checks.* At the start of each day, check your avalanche transceivers

(a) Reception. One member, with his unit on transmit, moves out from the rest of the group. He stops only when the remainder of the party-their units switched to receive-can no longer hears the signal.

(b) Transmission. The main group now switches their units to transmit, while the person out in front switches to receive. In turn, each party member moves toward the checker and continues past until out of range.

(3) *Locating Victims.*

(a) Lookout. Do not become a victim. Post a lookout to warn of new avalanches in the same area. If the lookout warns of another avalanche, everyone must immediately turn his transceiver to transmit.

(b) Location. Decide the most probable victim location.

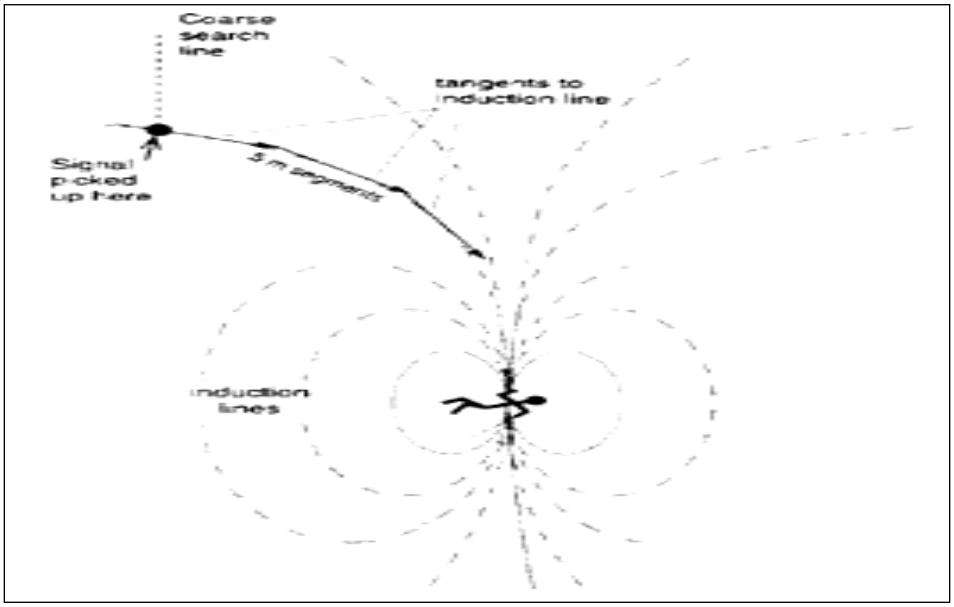
(c) Get On Line. Spread the searchers on line at thirty meters intervals. Insure everyone is set to receive at full volume. Move forward, maintaining the interval. Each searcher works independently.

(d) Avalanche Transceiver. The avalanche transceiver has been designed to make searching as simple as possible. The stronger the signal, the more LED's (inside the arrow) light up and the louder the sound. The large LED above the range dial is the range LED (some transceivers use distance to the victim in the visual display). The distances that are shown on the range scale are not exact measurements but they are a good gauge of the searching distance.

(e) Induction Search Pattern.

Search patterns begin when you first receive a signal. At this point LEDs will be faintly flashing. From this point, always hold the beacon horizontal with the arrow pointing away from you. Slowly rotate the beacon from side to side to determine the direction of the strongest signal – (most lights, loudest sound).Once direction is determined, precede in a straight line until the range LED flashes. Continue increasing the sensitivity of the beacon as the search area becomes smaller.

At this point, you will conduct a pinpoint grid search pattern. This is nothing more than placing the beacon close to the snow surface, moving it from side to side and forward and backwards to locate the strongest signal. When the strongest signal is determined, quickly spot probe the area up to a meter wide for the victim's location. Due to the depth of burial, the pinpoint search may have to be done in a higher setting.



Induction Search Technique Diagram

Avalanche Transceiver Components

d. **Avalanche Cord.**

(1) Avalanche cord is a lightweight, bright colored cord. Avalanche cord is obtained in 100-meter lengths.

(2) Insure the cord is tied securely to the individual. Allow the cord to trail. During an avalanche, the cord has a high probability of surfacing. Follow the cord to the victim.

e. **Probing.** Probing is the oldest and least efficient method of searching for an avalanche victim. To coarse probe an area 100 meters by 100 meters, using twenty probers with manufactured probes, it would require about four hours and the success ratio is approximately 70%. A single trained Soldier using an avalanche transceiver can search the same area with a success ratio of 98%.

(1) *Coarse Probe.* Used for immediate search of victim.

(a) Probers are spaced along a line, hands on hips, elbow to elbow. Place your feet about shoulder width apart. A string line to align the probers is helpful.

(b) A single probe pole insertion is made between the feet.

(c) On signal from the probe line commander, the group advances one-step and repeats the single probe.

(d) Use only these two signals for the complete sequence: "DOWN PROBE" and "UP PROBE" and "ADVANCE". By adhering to these commands, the leader can look along the probe line when the probes are down and instantly spot a "high" probe. A "high probe" will show a possible location for the victim. It is important to adjust the signals to a rhythm that enforces a maximum reasonable pace. Strict discipline and firm, clear commands are essential for efficient probing. The probers work silently.

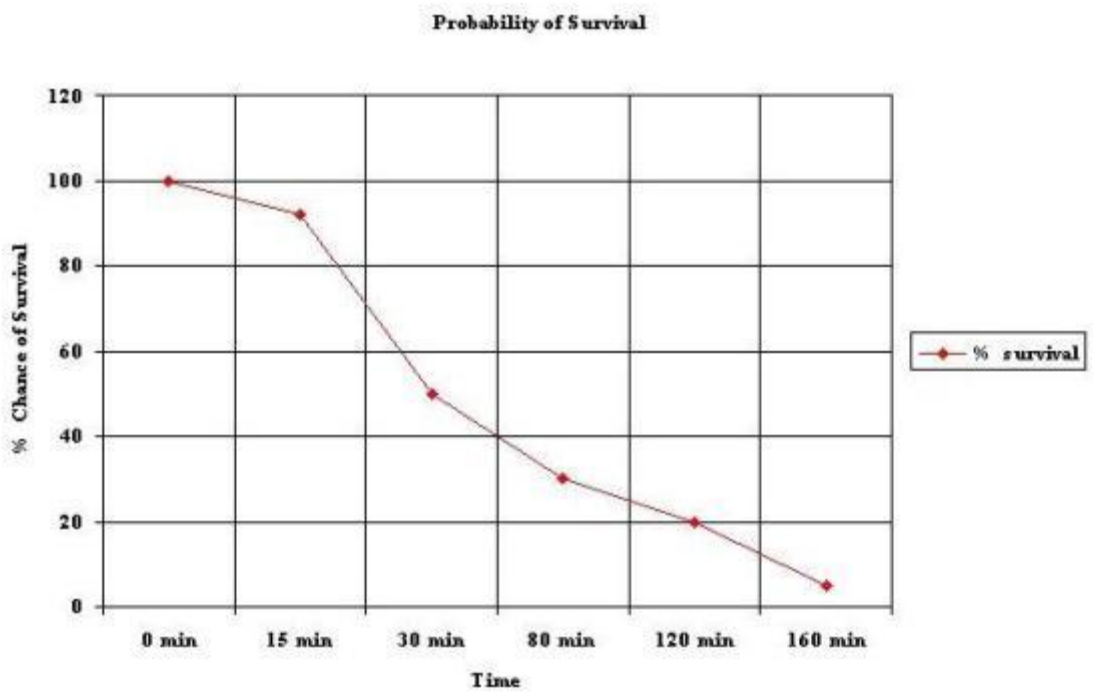
(2) *Fine Probe.* Fine probe is used to recover a body.

(a) Space the probers the same distance as for the coarse probe.

(b) Each man probes in front of his left foot, then in the center of his straddled position, and finally in front of his right foot.

(c) On command, the line advances one foot and repeats the probing sequence.

Table of Contents



Chance of Survival Rate Chart

a. **Shovel Crews and Trenching.**

(1) Shovel crews assist the probers, relieving them at intervals and digging in likely spots.

(2) Trenching is for body recovery if a fine probe fails. Before deciding to trench consider the dangers at the avalanche site plus the exceptional effort that trenching requires. Trenches are dug parallel to the contour, down to ground level or to undisturbed snow at intervals of two meters. Digging begins at the run out zone and proceeds uphill. Space the shovel teams along one trench. Throw the snow from one trench into the one just completed.

Table of Contents

NOTES:

Avalanche Hazard Evaluation Checklist

Critical Data		Hazard Rating*		
PARAMETERS:	KEY INFORMATION	G	Y	R
TERRAIN: *Is the terrain capable of producing an avalanche?*				
• Slope Angle (steep enough to slide? prime time?)		❑	❑	❑
• Slope Aspect (leeward, shadowed, or extremely sunny?)		❑	❑	❑
• Slope Configuration (anchoring? shape?)		❑	❑	❑
	Overall Terrain Rating:	❑	❑	❑
SNOWPACK: *Could the snow fail?*				
• Slab Configuration (slab? depth and distribution?)		❑	❑	❑
• Bonding Ability (weak layer? tenter spots?)		❑	❑	❑
• Sensitivity (how much force to fail? shear tests? clues?)		❑	❑	❑
	Overall Snowpack Rating:	❑	❑	❑
WEATHER: *Is the weather contributing to instability?*				
• Precipitation (type, amount, intensity? added weight?)		❑	❑	❑
• Wind (snow transport? amount and rate of deposition?)		❑	❑	❑
• Temperature (storm trends? effects on snowpack?)		❑	❑	❑
	Overall Weather Rating:	❑	❑	❑
HUMAN FACTORS: *What are your alternatives and their possible consequences?*				
• Attitude (toward life? risk? goals? assumptions?)		❑	❑	❑
• Technical Skill Level (traveling? evaluating avalanche hazard?)		❑	❑	❑
• Strength/Equipment (strength? prepared for the worst?)		❑	❑	❑
	Overall Human Factors Rating:	❑	❑	❑

DECISION/ACTION:

Overall Hazard Rating/Go or No Go? GO ❑ or NO GO ❑

* HAZARD LEVEL SYMBOLS: R = Red light (stop/dangerous), G = Green light (go/OK), Y = Yellow light (caution/potentially dangerous).

Avalanche Checklist

Table of Contents

15-Hauling Techniques

071E9022

INTRODUCTION: When working in the mountains, it may be necessary to raise a heavy load such as ammunition or casualties using a mechanical advantage. Hauling systems allow Soldiers to move critical loads up steep terrain while reducing fatigue and injury. Understanding how to establish hauling systems will greatly enhance a unit's ability to effectively conduct operations in the mountains.

Identify site selection criteria.

a. Site Selection Criteria. Site selection is governed by many different factors:

(1) Working Platform. Make sure that the loading and unloading platforms are free of loose material, no sharp edges are present and that they are large enough for hauling operations. The loading / unloading platforms are easily accessible and provide a safe working area.

(2) Personnel. Keep Soldiers away from the edge until a safety rope is in place (if appropriate).

(3) Terrain.

(4) Equipment.

(5) Load.

(6) Anchors. Make sure that anchors are available and suitable to handle large amounts of force.

(7) Tactical situation.

b. Hauling Systems. There are many different hauling systems, ranging from main force (everybody grabbing one end of the rope and hauling) to power winches. One type of hauling system is the Simple 3:1 System, otherwise known as the Z Pulley.

Construct a simple 3:1 hauling system.

a. Hauling system theory.

(1) In theory, the mechanical advantage is 3:1, meaning it takes 1 lb. of force to raise a 3 lb. load. In reality, the actual mechanical advantage is less than the 3:1 ratio because of friction. Pulleys offer less friction, and therefore higher mechanical advantage, than carabiners. Use pulleys if available.

(2) The less friction in the system the closer to the theoretical mechanical advantage. Friction is caused by:

(a) Rope running through carabiners.

(b) Load rubbing against a rock wall.

(c) Condition of the rope.

b. Construction of the Z-Pulley System.

(1) Attach the rope to the load. Make sure that the attachment point is load bearing and the rope is correctly attached to it directly or with locking carabiners.

(2) Anchor Point.

(a) Establish an anchor point

(b) Attach the rope to the anchor

(c) If needed safety yourself to it (i.e. when working near a cliff edge).

(3) Anchor Prusik (AP), also called the **Ratchet**. Construct the anchor Prusik.

(a) Pull up all of the rope until you feel the load.

(b) Place the load rope into a carabiner in the anchor.

(c) Tie a Prusik on the load rope and secure the two free ends with a Munter mule to the anchor point with a locking carabiner.

Table of Contents

Note: The Munter mule knot is used in case the load is stuck and needs to be released for lowering.

(4) Moveable Prusik (MP) also called the **Tractor**.
(a) On the load rope, tie a Prusik as close to the edge as the loading platform and available rope allow.
(b) Tie a double-double figure eight with the utility cord, as close as possible to the Prusik.
(c) Place a carabiner into the doubled-double figure of eight.
(d) Route the running end of the rope coming from the anchor point through this carabiner.

Note: High-efficient pulleys at carabiners are preferred to maximize mechanical advantage.

b. Procedural Points.
(1) You lose mechanical advantage once the MP contacts the AP.
(2) Locate the anchor far back from the edge for more area to pull.
(3) Pull all ropes as parallel to the load rope as possible.
(4) Pull the load slowly, loosen the AP. When the MP reaches the AP, set the AP and move the MP as far down the rope as possible.

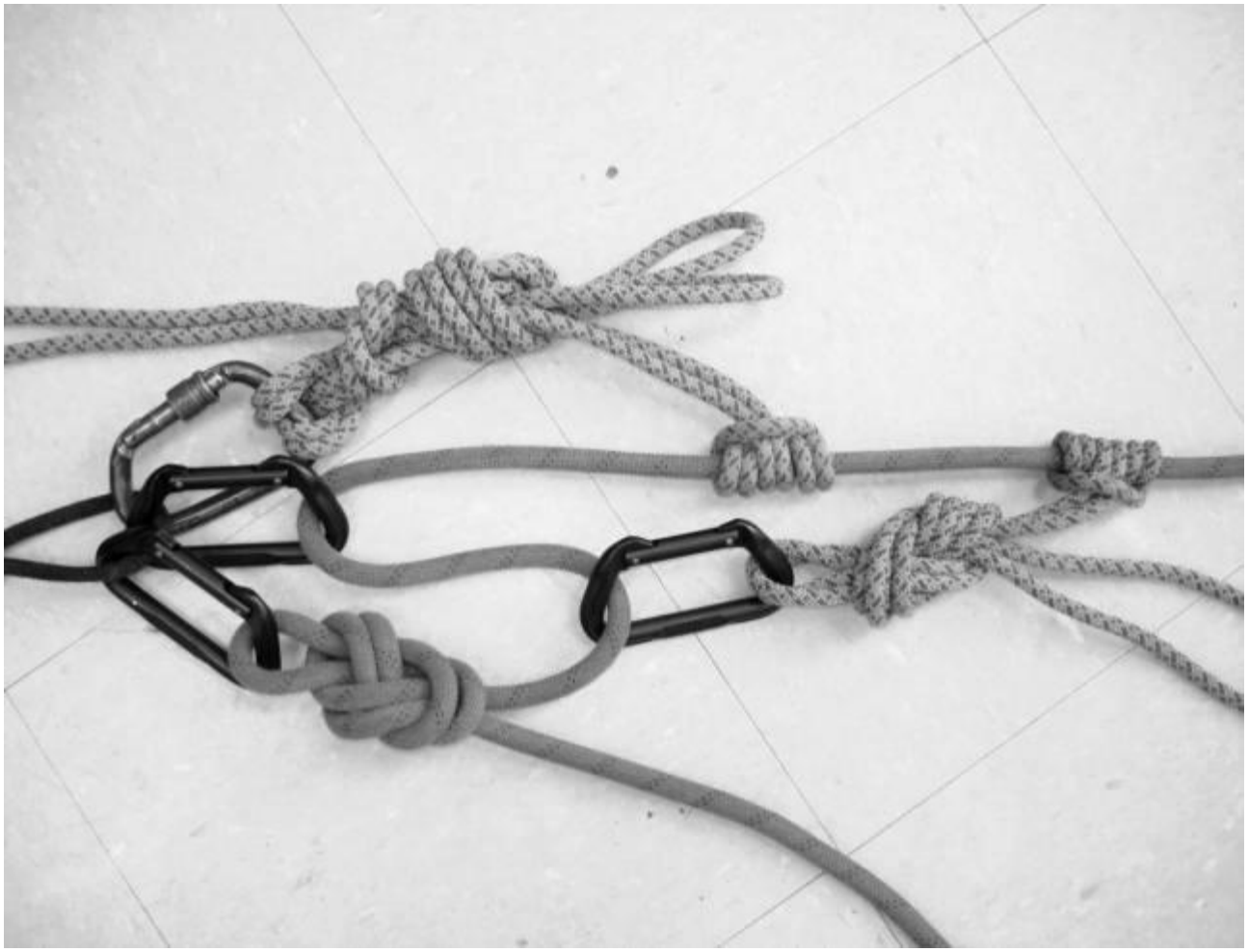
Note: Close the system at the end of the haul or when you need to walk away by tying and placing a double figure 8 knot into a carabiner at the anchor.

c. Caution Measures.
(1) When using hauling systems and mechanical advantage, it is possible to overload anchors and equipment.
(2) Mechanical advantage reduces your sensitivity to the load.
(3) Protect the rope from edges to avoid abrasion and to reduce friction.

Use a Simple 3:1 Hauling System.
a. Z-Pulley as a hauling system.
(1) Hauling equipment.
(a) Use static rope if available.
(b) Use directional's to route the load rope properly, avoid contact with the rock or ground if possible.
(2) Hauling/assisting/rescuing personnel.
(a) Use static rope if available.
(b) Ensure the system is closed at all times, with no more than the possibility of a 10-15 foot fall.
(c) Be aware of the loss of load sensitivity to avoid hanging up the load.

b. Z-Pulley as a tightening system.
(1) High-Line crossing.
(a) Use the Z-Pulley if the loading platform is small during a river crossing or a High-Line crossing.
(b) Once the system is tight, leave the MP in place, with the tension held by the AP and close the system.
(c) See High-Line, 071E9024

Table of Contents



Simple 3:1 Hauling System

Table of Contents

Notes:

16 - Environmental Effects on Weapons

071E9038

INTRODUCTION: Operations in the mountains provide unique problems for the employment and function of small arms and other weapon systems. Cold temperatures, wind and slope of terrain are just a few conditions that can affect weapons and ballistics. Soldiers who understand these problems and how to solve them greatly add to the lethality of their unit. A Soldier's ability to identify, engage and reduce targets at the maximum effective range of his weapon gives him a great advantage over the enemy.

Identify Environmental Factors Affecting Weapons Function.

a. **Factors Affecting Weapons Functioning.**

(1) **Lubricants.** In warmer climates, Soldiers have multiple options to lubricate their weapons systems. However, choices become more limited as Soldiers operate in extremely cold climates. Most lubricants thicken at colder temperatures, causing weapons to become sluggish or freeze causing malfunctions. The use of LAW (Lubricant, Arctic Weather, NSN 9150-00-292-9689) is the established cold weather lubricant for the Army (refer to each weapons TM for appropriate temperatures to apply LAW as it varies). The use of LAW provides the necessary lubrication without the resulting malfunctions caused by CLP or LSAT in cold weather.

(2) **Condensation**. Condensation will form on weapons when they are taken from a cold environment into any warmer environment (buildings, shelters, vehicles etc). This process is commonly known as "sweating" and can cause weapons under certain conditions. By moving weapons from a warmer area to a colder area without proper maintenance, the condensation will begin to freeze, causing internal components to seize up and function. For this reason, it is best to leave weapons outside during freezing temperatures (when possible). When left outside, weapons should remain accessible but sheltered where ice and snow will not get into the working parts, sights or barrel. When weapons have to be taken inside for cleaning, the condensation or sweating process, once started, will continue for approximately one hour. It is recommended to wait until this sweating process has concluded (approximately 1 hour) before cleaning the weapon. Inside a shelter, a weapon should be kept near the floor to minimize condensation. When operating in vehicles or aircraft, the interior climate of the troop compartments should be maintained as close to freezing (32°F) to prevent condensation from building on weapons.

(3) **Breakage and Malfunctions.** Breakage and malfunctions occur as the extreme cold cause's metal and plastic to become more brittle than normal. Breakage generally occurs early in firing when the components are warming, expand rapidly and unequally. After a weapon has been fired, the heat that it has generated can cause condensation or melt any snow or ice that was on the weapon. As the weapon begins to cool, this moisture will begin to freeze causing malfunctions or stoppages. Weapons should be kept free of snow and ice whenever possible to minimize this effect. Careful handling of weapons when moving through snow and ice covered woods and allowing weapons to warm up by firing initially at a slow rate eliminate many of the problems. Additionally, Soldiers must be aware that the metal can cool to the point where it must not be touched by bare hands.

(4) **Visibility.** Visibility may be difficult because of firing weapons in temperatures below -20F. As the round leaves the weapon, the water vapor in the air is crystallized creating minute ice particles. The ice particles produce ice fog. If the air is still, the fog can remain along the gunner's line of sight for several minutes. When faced with this problem, fire at a slower rate and/or relocate to another firing position. In anticipation, always prepare supplementary firing positions, which will cover assigned sectors of fire.

(5) **Emplacement.** Most crew-served infantry weapons need a natural "base" or gun platform to fire accurately. In warmer climates, the ground provides a solid base and yet has

enough resilience to act as a shock absorber. In winter, a soft snow "base" gives under the recoil of the weapon. If the weapon is emplaced on solid frozen ground, there is no give. The weapon absorbs all the shock of firing. This shock may result in breakage. The slippery surface of the frozen ground may also allow the weapon to slide. If the snow is not too deep, and time is available, tripods and/or base plates should be dug in. To solve this problem in deep soft snow, the improvised use of snowshoes, skis, sleds and/or field expedient platforms is recommended. Mortar base plates must still be dug in. Sandbags filled with compacted snow will help to stabilize the firing platform. Success can be achieved by setting the mortar base plate within a discarded tire.

(6) **Snow and Ice.** To keep snow and ice out of the weapon, some type of cover is required. Improvised covers are easily made from ration packet material. Any type of material can be used, even plastic bags.

(7) **Munitions.** Cold weather can affect the accuracy of weapons and the performance of munitions. Magazines must be cleaned of all oil and preservatives and checked frequently. Munitions should not be lubricated. When brought from a cold area into a warm space, munitions will sweat. Any ice and condensation must be removed. To prevent these problems, leave munitions outside when moving inside for short periods. The performance of munitions are also affected by the cold. The burning rates of various types of propellant charges are slowed due to cold temperatures. Weapons zeroed under temperate conditions or with ammunition that has been warmed, will fire low in extreme cold. Generally, ammunition provides poor fragmentation in snow.

(8) **Machine Guns.** Machine guns (MGs) break and malfunction at a higher rate in cold weather. Gun crews must plan for this by carrying extra sears and bolt parts. One common malfunction that occurs early in firing is short recoil (bolt does not recoil fully to the rear). The prescribed immediate action for the particular weapon should be applied. As the metal warms, the problem will diminish. A second type of malfunction is caused by the freezing and hardening of buffers. This in turn causes great shock and rapid recoil, thereby increasing the cyclic rate. When this happens, parts usually break. All internal parts and friction surfaces of MGs should be coated with LAW. These weapons have fewer malfunctions when fired cold and dry if sub-zero lubricants are not available. Firing should consist of short, two- or three-round bursts fired at close intervals. Since ice fog greatly impairs the gunner's vision along his line of sight, crews must prepare two or three alternate gun positions. After changing barrels, if the hot barrel is laid directly on snow or ice, it may warp or disappear in deep snow. A tarp or poncho keeps barrels from warping or disappearing.

(9) **Back Blast.** The cold increases the back blast effect of all recoilless-type weapons by a factor of at least three. Since the back blast areas are significantly increased, all personnel must be instructed to plan for this hazard when fighting or training with recoilless-type weapons.

(10) **Cold Weather Hand Gear.** When Soldiers wear mittens, the speed in handling and firing weapons is reduced. However, this is not an excuse for not wearing hand protection. Under extreme cold, bare flesh freezes instantly to weapons. Soldiers should be trained to operate their weapons while wearing hand gear. For extended operations in extreme cold, armorers should remove the trigger guards.

Identify Effects of Temperature on Weapons.

a. **Effects of Cold on Munitions.**

(1) **Small Arms Munitions**. The effect of the cold on small arms munitions is minimal. Velocity is lowered slightly, which causes the round to drop slightly. To overcome this:

(a) Battle sight zero all weapons when they arrive in the cold weather operating area.

(b) Range estimation will come with experience. Use tracers if the tactical situation allows.

Table of Contents

(c) Increase munitions allocation. Because of the effects of cold weather clothing, differences in range estimation, and the effect of the cold on the human body, marksmanship will be reduced. Consequently, munition allocations must be increased.

(2) **Mortar Munitions**. The effect of snow will decrease the munition's effectiveness. To combat this use variable time fuses set to trigger above ground. Munition allocation will also have to be increased. Dud rates are much greater and must be planned for. The snow will also absorb much of the effect of functioning mortar rounds.

(3) **Artillery Munitions**. Artillery munitions will be affected by the cold with a result of about 100 meters short for every 1,000 meters of range. Fire Direction Control (FDC) can compensate if a precision registration is done prior. Illumination rounds may malfunction and fail to open. However, functioning rounds will be more effective because of reflection off the snow pack. Deep snow will absorb the bursting radius. When firing on frozen ground with little or no snow cover, the effects of artillery rounds will be enhanced. Family of Scatterable Mines (FASCAM) may be used to cover mountain passes or to block the movement of a fleeing enemy. Although rarely used, these mines self-destruct and can be emplaced over snow covered terrain.

(4) **Guided/Unguided Antitank Missiles.** All antitank missiles are designed to function properly at temperatures down to –20°F. However, at lower temperatures their accuracy will decrease because of the following:

(a) The effects of the cold on a Soldier's ability to function. The firing hand may feel numb due to the cold and heavy mittens/gloves. Practice wearing anti-contact gloves will aid but not eliminate this problem.

(b) Optical sights fog immediately if breathed on. Gunners should wear masks when firing.

(c) Ice fog requires antitank gunners to prepare multiple positions if temperatures drop below 20°F. These positions should be 100m to 200m apart and pre-stocked with munitions.

(d) The wire guidance system shorting out can cause runaway missiles. Wet snow makes contact with the wire through a break in the coating or by a break from extreme cold.

(e) Battery failure can cause misfires.

b**. Temperature**. The higher the temperature, the less dense the air is. If the Soldier zeros at 60°F and he fires at 80°F, the air is less dense, thereby causing an increase in muzzle velocity and higher point of impact. A 20°F change equals a one-minute elevation change in the strike of the bullet.

Note: Temperature data is only for M852 168gr match ammo for the 7.62. These numbers will vary for other rounds.

Identify Effects of Altitude on Weapons.

Air is less dense at higher elevations, which produces less drag, giving you a higher impact on the target. Calculations should be made at 1 MOA for every 2500ft change in elevation. This is a bigger change than previously believed.

a. **Angle Calculation.** In the Mountains, a Soldier is required to accurately determine distance. This skill set is often overlooked in an urban environment. While operating in the Mountains, targets will be much further. Instead of firing from rooftops, it will be hilltops. Instead of across a parking lot, it will be across a valley. To properly adjust elevation on your weapon system, the Soldier has to be skilled in various range estimation techniques. In most cases, it will be hasty. If time permits, additional methods should be used to determine accurate range.

Most practice firing conducted by the Soldier involves the use of military range facilities, which are relatively flat. However, as a Soldier being deployed to other regions of the world, the chance exists for operating in a mountainous or urban environment. This requires target engagements at higher and lower elevations. To most Soldiers, targets looked down upon will seem farther. On the other side when looking up the Soldier will tend to underestimate the distance. Unless the Soldier takes corrective action, bullet impact will be above the point of aim. How high the round strikes is determined by the range and angle to the target. The amount of elevation change applied to the optic or sights of the rifle for angle firing is known as “slope dope”.

Angles and Cosines: The cosine is a trigonometry function to angles. The first step in getting a cosine is to get the angle. There are several methods to find the angle.

(1) **Clinometer.** This instrument is specifically made to measure angles. The easiest to acquire and most common is the Silva Ranger compass, with an internal clinometer. Simply hold it up to your eye, line up the flat edged based of the instrument case on the same path to the target, and read the angle where the North seeking pivot arm rests.

(2) **M2.** This is a compass found in all mortar platoons and artillery batteries, used to lay gun lines. It has the capability of measuring angles. Look through the peep sight to the target and manipulate the arm until the bubble is centered in the level. When the bubble is up, read the angle.

(3) **Standard Map Protractor.** First, in the center of the protractor, install a piece of string to act as the angle reading line. (The end of the string may need to be weighted) Then lay the protractor on the barrel or scope with 90 degrees in the direction of the target. Aim at the target and read the angle from the string.

(4) **Half-moon protractor with pivot arm.** Place the flat end of the protractor up, and flat plain. Next use the pivot arm to mark the angle of the rifle barrel, or aim the pivot arm at the target. Read the angle where the pivot arm crosses the protractor.

(5) **Plumbing Tools-** Various tools are available to obtain angles designed for plumbers at hardware stores to obtain angles

(6) The **“Angle Cosine Indicator,”** is a simple tool for Soldiers in mountainous terrain, and utilized to obtain their corrected for gravity distance to target. The ACI is a vault solid, water resistant precision instrument; quiet and made from aircraft grade aluminum, which is anodized in a flat black color. The Co-Sine numbers are Laser Engraved onto the body in five (5) degree increments. The lens is shatter proof, shock proof and resistant to chemicals such as acetone and cleaning solvents. It is completely mechanical, there are no batteries to fail, no electronics to fail. A mounting bracket is available for a rail system.

(7) **Laser Range Finder.** The laser range finder is the most accurate of all methods. Unfortunately, most rangefinders do not give slope distance, just line of sight. You as the shooter will still have to calculate the angle and adjust your dope accordingly. Exceptions to this include, the Leica Viper Vector IV available through the system. With capabilities of over 5000 with the inclinometer. Alternatively, the Leopold RX, and the Bushnell elite series. Both of these have a built in inclinometer that offer true ballistic ranges. The lasers have a 1500Y capability and offer true ballistics to 800Y.

Table of Contents

Angles affect the size of the target at any range or angle. It does not become obsolete at a certain distance or angle. The round could still strike a target if the target is large enough and at closer ranges.

Once the angle is obtained, look on the angle cosign chart (below) and use the cosine number that matches the angle in the following formula.

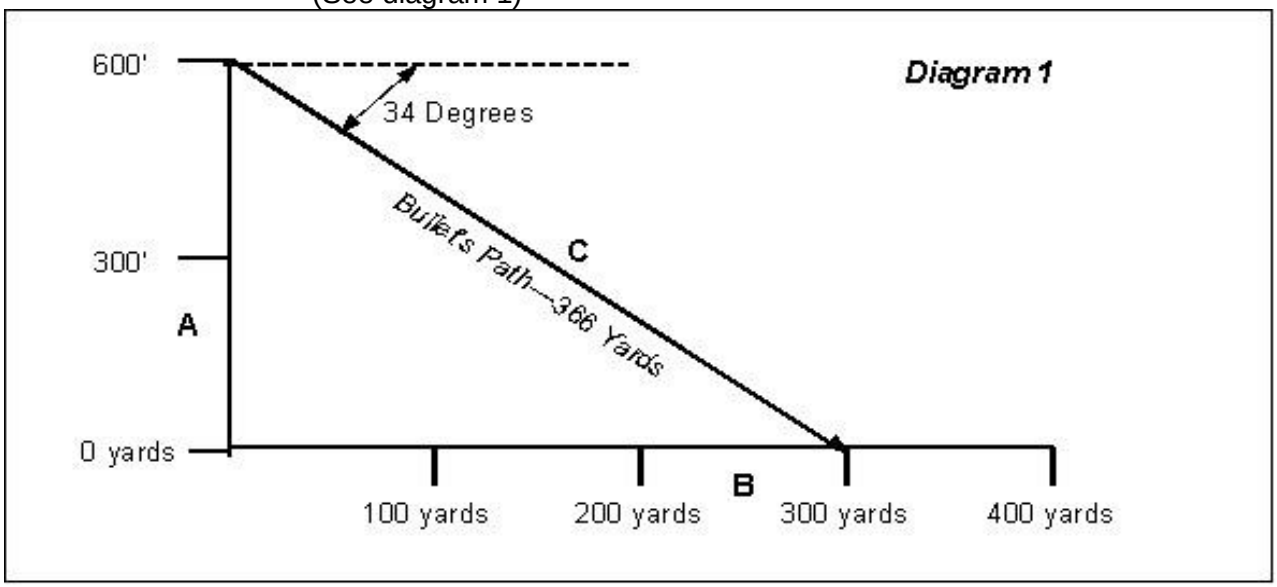
Angle	Cosine	Angle	Cosine	Angle	Cosine
0	1	32-33	0.84	55	0.57
1-8	0.99	34-35	0.82	57.5	0.53
9-11	0.98	36-37	0.80	60	0.50
12-14	0.97	37-40	0.78	62.5	0.46
15-16	0.96	41	0.75	65	0.42
17-18	0.95	42	0.74	67.5	0.38
19-20	0.94	43	0.73	70	0.34
21-22	0.93	44	0.72	72.5	0.30
23	0.92	45	0.70	75	0.26
24	0.91	46	0.69	77.5	0.215
25	0.91	47	0.68	80	0.17
26-27	0.89	48	0.67	82.5	0.13
28	0.88	49	0.65	85	0.09
29	0.87	50	0.64	87.5	0.045
30-31	0.86	52.5	0.605		

Table of Contents

Cosine Formula: The cosine adjusts for the angle giving the distance in which the round will actually be affected by gravity. The elevation setting is set for the flat ground distance. It does not adjust the actual trajectory, this makes it work for all calibers and velocities and any type of weapons system. The cosine formula is as follows.

The actual range X cosine = flat ground distance

Example: For an estimated (actual) range of 366m at a 34-degree angle.
The cosine for a 34-degree angle is .82
366m X .82 = 300m
(See diagram 1)



The actual range of 366m will be used for windage and time of flight formulas. The flat ground distance of 300m will be used for the elevation.

Milliradian Range Estimation: It has been shown before that the mil relations formula becomes inaccurate after approximately 700 yards due to the human eye not being capable of accurate reading of targets the height of a man or smaller past that range. It is highly recommended that at least two methods of range estimation techniques be used at all times.

Identify the Effects of Snow Fortifications on Munitions.

a. **Introduction.** Digging into completely frozen ground is a formidable task to an infantryman. It is approximately ten times faster to build above ground snow positions than to dig in frozen ground to obtain the same degree of protection. Traditional fighting and protective positions in cold regions can be excavated with combined methods using hand tools, excavation equipment, or explosives. However, excavation in frozen ground is extremely difficult and hand tools may be of little use. Heavy equipment use is limited by traction, maneuverability, elevation, and the tactical situation. Explosives are an expedient option, but require larger quantities than in normal soil and are again limited in tactical situations. With proper training and leadership, there may not be a need for "digging in" for combat on snow-covered terrain.

b. **Factors.** There are many factors that will determine how effective snow fortifications will be in protecting their occupants; the snow's age, temperature, density, hardness, grain size,

presence of debris, etc. The most important factor however, is its density, which affects how deep a bullet or shell fragment will penetrate. Snow density will directly affect how thick or how much snow is needed to stop a given projectile.

c. **Standard above Ground Positions**. If the soil is frozen to a significant depth, the Soldier equipped with an E-tool and ax will have difficulty digging a fighting position. Under these conditions, (below tree line) snow and wood are often the only natural materials available to construct fighting positions. The fighting position is dug at least 20 inches deep, up to chest height, depending on snow conditions. Ideally sandbags are used (filled with packed snow) to reinforce the interior walls for added protection and to prevent cave-ins. If sandbags are not available, a lattice framework is constructed using small branches or, if time permits, a wall of 3-inch logs is built. A platform of plywood, timber or snowshoes is constructed to the rear of the frontal protection to provide a solid base from which to employ the weapons. Overhead cover is offset because of the difficulty of digging both the firing and protective positions together in the snow. The protective position should have at least 3 feet of packed snow as cover. The fighting position should have snow packed 8 to 9 feet thick for frontal, and at least 2 feet thick for side protection. Packed snow, rocks, 4-inch diameter logs, or ammunition cans filled with snow are sometimes used to complete the frontal and overhead protection, as well as side and rear parapets.

d. **Alternative above Ground Positions.**

(1) **Individual Fighting Position in Snow.** Positions for individuals are constructed by placing packed snow on either side of a tree and extending the snow parapet 8-9 feet to the front. The side and rear parapets are constructed of a continuous snow mound, a minimum of 2-feet wide, and high enough to protect the Soldier's head.

(2) **Snow Trench with Wood Revetment.** In deep snow, trenches and weapon positions are excavated to the previously described dimensions. However, unless the snow is well packed and frozen, revetment is required. In snow too shallow to permit the required depth of excavation, snow walls are usually constructed. The walls are made of compacted snow, reinforced, and at least 6.5 feet thick.

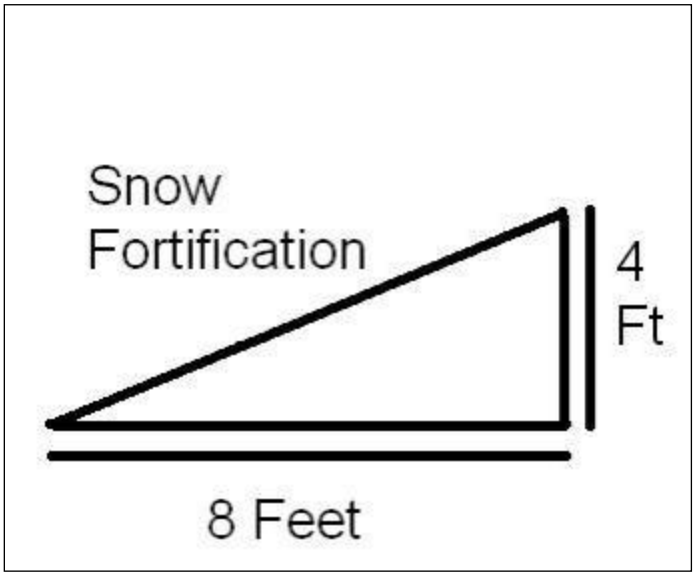
f. **Snow and Ice Crete**. Soil and snow deposits that have been excavated can be mixed with water (when available) and placed around the excavation as additional fortification. As this soil freezes, it will form what is commonly referred to as ice-crete or snow crete, which affords excellent protection against small arms fire. If available, ice crete can be made into solid blocks by using ammo crates or MRE boxes as molds, which are, removed once the ice crete freezes. Snow or ice-crete is best used on the inside of the positions next to the occupant because it acts as an effective stopper once the round is slowed down and tumbled through the less dense snow on the outside of the position. It is also more brittle and will degrade quicker if exposed to sustained direct fire.

g. **Other Materials.** Firing positions in snow can also be reinforced with local materials such as ice, wood, branches or gravel. Sandbags, ammo cans or grain bags filled with snow are also effective in reinforcing the walls of the position. Even small amounts of rocks or sticks can be effective when packed in snow or made into the ice-crete molds. The debris will cause the round to tumble, which severely limits the penetration of the round.

h. **Indirect-fire Rounds and Grenades.** Heavier projectiles, artillery shells, mortar rounds, hand grenades, and rifle grenades are also seriously affected by snow. If explosive rounds like these are fired or thrown into snow-covered terrain, they will almost never detonate at the snow surface level with maximum effectiveness. Instead, they detonate either at the surface of the ground underneath the snow or, at best, within the snow cover. The fragmentation effect circle is very small compared with free surface bursts; it may be reduced as much as 70-80% and the fragments will only travel a few meters in the snow. Unless the round falls almost directly on the target, the target will probably survive. The degradation effect of a snow cover may be significant even if it is as shallow as 18-20 cm. Table of Contents

It follows that warfare requires significantly more ammunition when conducted on snow-covered ground in winter than it does in summer. The fuse action of explosive rounds aimed at, and hitting, artificial protecting structures such as ordinary snow berms causes the rounds to explode within them. The rounds that fly through them are usually duds. Generally, an area bombarded with flat-trajectory fused explosive munition becomes "dud-infested".

i. **Snow Fortification Dimensions.** Minimum dimensions of a properly constructed snow fortification that will effectively stop small arms fire up to 7.62mm should be 8 feet long by 4 feet high by 4 feet wide and it should be in a wedge shape. The wedge shape helps deflect the rounds and is a very important part of the construction. As a general rule, the more consolidated the snow is the more effective it will be at stopping rounds. The less consolidated the snow the less effective it will be at stopping rounds. If resources are available it is critical that you put other materials such as sticks in the snow as well as because it gives the snow fortifications more stopping power. Average penetration from our personal field test (non-scientific) with snow fortifications built to the dimensions described above has been 3 to 4 feet. Our non-scientific data differs from the scientific data, which shows dramatic changes of penetration from the different snow concentration.



Snow Fortification Diagram

Notes:

Table of Contents

17 - Animal Packing
071E9050

INTRODUCTION: From horse drawn chariots 3800 years ago, to Special Forces teams on horseback in Afghanistan, the use of animals in war has always been a force multiplier. The usage of Pack Animals allows Soldiers to reduce combat loads and increase sustainability during long operations. Understanding the basics of how to select, pack and care for pack animals can mean the difference between mission success and failure in the mountains.

Identify pack animal use considerations.
a. **Infrastructure considerations**. In many developing countries, road systems are generally in poor condition. Spring run off, landslides and the lack of money and equipment to maintain road systems can bring wheeled and tracked vehicles to a complete stop. Resupply by air is often hampered by weather, PZ and LZ limitations and lack of air asset availability. This can create the need to use an assortment of pack animals when it comes to transportation requests. Being prepared to use locally obtained pack animals to bring materials through otherwise impassable roads and terrain, will allow you to continue to bring the fight to the enemy.
b. **Animals in Theater**. The last pack animal unit in the U.S. Army was disbanded in 1953. Units will not bring pack animals into theater. Another option is to acquire animals from the local population. Knowing how to choose animals that will perform the job for the task required is important to ensure mission success.

Identify parts of pack animals.
a. **Nomenclature.** There are five main parts to the animal. They are the following: head, neck, back/barrel, front quarters, hindquarters.
b. **Conformation.** Conformation describes what goes into the selection process for determining what a good pack animal should look like with regard to size, shape, height, weight and dimensions. Good conformation is marked by a steady intelligent mind, short strong neck, well-defined withers, large muscular chest, and a short, straight, well-muscled back and loins. Knowing what to look for in an animal will allow you to avoid sick or weak animals that would otherwise compromise your mission.
c. **Selection.** Avoid any animal that looks weak or frail. Drugs may have been administered before your arrival to improve the animal's looks or condition. Old scars and open wounds are a sign of hard use and poor treatment. Protruding rib and hipbones are signs of an undernourished animal. If the animal looks dubious at first glance, do not use it.

Acquiring pack animals.
a. **Bargaining**. Avoid going into a village and choosing the first animals you come across. Talk with the elder and let him know your needs. Closely inspect the animals. Take pictures of the animals for further study later. Haggling is often part of local culture. The price you agree on will affect the price for others trying to acquire animals in the future. Do not accept the animals that day if possible. Some may have been drugged to hide an injury. One technique is to arrange to pick them up the following day, but wait two days before coming unannounced. Have the same animals gathered up, then compare. Any drugs given the first time will have worn off by the time you come back.
b. **Interpreters.** Insure that the interpreter is telling the elder what you are saying and not any more.

Table of Contents

Load planning factors and considerations.

a. **Planning.** Check within the unit to see if anyone has experience working with horses. These individuals can assist the local animal owner with handling the animals throughout the movement. It is recommended that no less than two people be assigned for every ten animals for control purposes. Cross load equipment in case of attack. For security reasons, if packing ammo or other sensitive items, those animals should be handled by U.S. personnel only.

b. **Packing.** All items to be loaded should be planned out so that each pair of bundles are balanced to within 5 lbs of each other and placed on the animal at the same time. This will ensure that the load rides evenly on the animal. Placing loads should be done as quickly as possible. The goal should be to take no longer than 30 minutes to load all the animals. Begin the movement immediately after the last animal is packed.

c. **Leading.** Never coil the rope around your hand. Hold loose bights to prevent you from being caught in a loop if the animal runs. Be aware of your surroundings at all times to prevent injuries. Maintain firm control if leading an individual animal. Stand at or just in front of the animal's head.

d. **Loads**. In general, the total load place on an animal should not exceed 25% of the weight of the animal. For small horses and donkeys, the average load is about 80 - 100 pounds. Consideration for the condition of the animal, durability of native pack equipment, terrain, and distance to be covered should be factored into the load plan weight.

Identify pack load considerations.

e. **Building a Load**. Loads should be constructed so the load does not injure the animal or spill out the contents. The basic items needed for building a load can be varied. Blankets, canvas tarps, ponchos (light loads), sleeping bags, rucksacks and duffel bags all can be used to haul equipment.

f. **Mantee Bundle.** The mantee is an 8' x 7' piece of 12 to 18oz canvas or similar sized material. Laid flat on the ground, the load is placed in the center so that the corners of the mantee bisect it. The sides are tucked in and folded over the load followed by the ends. Tension must be maintained while folding to ensure a tight final product.

g. **Tying Off**. A 3/8"diameter rope 36 feet long with a small fixed loop at one end is needed to tie up the mantee. Bring the rope around the long axis of the load and bring the running end of the rope through the fixed loop. Pull this back on its self as tightly as possible. Make a series of half hitches around and down the load roughly 1/3 the distance at a time. Secure the end of the

rope with a tightly dressed down overhand slip knot secured with two half hitches. Place any remaining rope under the wraps to hold it secure.

Mantee bundle

h. **There are two types of commercially manufactured saddles**. The Sawbuck saddle and the Decker Saddle. More than likely you will not be deployed with animals and tack, but you may be able to purchase some tack prior to your deployment.

i. Tack can be made from sling ropes, LBE/LCE, and Canvas with initiative and imagination.

Table of Contents

Sawbuck frame

Decker frame

Identify the characteristics of horses, mules and donkeys.

a. **Horses**. Almost any horse used for riding can be used for packing. If you are on horseback, your pack animals should be horses in order to maintain the mobility of the mounted element. Horses carry about 65% of their weight on their front legs. This makes them less suitable for rough terrain or downhill movement. Horses are more skittish to loud noise and sudden movements. They are also more prone to foot problems than other pack animals.
b. **Mules.** Mules are the hybrid product of a male donkey and a female horse. Mules are sterile and cannot be bred. Mules carry about 55% of their weight on their front legs giving them better balance and footing than horses in rugged terrain. The term "stubborn as a mule" stems from the mules strong sense of self-preservation. If a mule thinks it will be injured it will refuse to go any further no matter how much persuasion is used. Mules form very close bonds with horses, especially mares. It is good practice to have at least one mare with a mule pack. The mules will willingly follow a bell mare. Even while grazing at night, mules will not venture far from the mare. Harsh treatment of these animals will lead to control problems later on. Mules will respond to an untrained handler better than a horse. Pound for pound, you will get more work out of a mule than a horse. An adult healthy mule will be able to carry a two hundred pound load all day.
c. **Donkeys.** Donkeys evolved in the desert. Their bodies are very efficient at conserving water, even pulling excess moisture from their dung before voiding it. Their tough compact hoofs handle sand and rock well. They do not sweat as much as horses due to having a smaller muscle mass. Large ears help to dissipate heat and can locate sound direction very well, alerting you to unseen danger. Like mules, they will instinctively attack any canines deemed a threat. They have a digestive system that is able to break down and get nutrients from almost anything. Donkeys also have a strong sense of self-preservation. Donkeys range in size from 36" to 56" high at the shoulder.

Identify animal feeding considerations.
a. **Feeding**. Feeding pack animals in theater will create logistical problems if there is not enough natural forage to be found. Animal field rations are determined by their weight. A 1000 lb mule will require 14 lbs of forage and 10 lbs of grain each day. A 400 lb donkey will need 12 lbs of forage and 2 lb of grain. These amounts will increase with a heavy workload. Half of the amount is usually given in the morning and the other half at the end of the workday.
b. **Free-range Food**. To meet the animal's daily requirements, a pack animal left to feed on its' own will need a grazing area large enough to feed for six hours with out having to lift its' head to look for and move to more food. Flakes of hay should be in some kind of manger to keep it off the ground to prevent mold and debris from contaminating the feed.
c. **Water Needs**. Water is critical to the animals ability to digest its' food and maintain its' health. A mule will require between 4-8 gallons per day (gpd), a donkey 2.5 – 5 gpd and a horse 8-12 gpd. These amounts are a daily total; the animals should be allowed a portion of this amount several times a day. A fast pace or hard exertion should be delayed for about a half hour after watering on the march to avoid digestive disturbances, which could kill the animal.

Identify animal health considerations.
a. **Animal Health**. Animals acquired in theater will more than likely be tired and beat down already. Your job will be to select the best animals available to accomplish your mission. In general, injuries above the animal's knees are treatable because of more muscle tissue and blood supply. Suture kits and medicated salve (Bag Balm) for cuts and abrasions are likely all you need. Wounds below the knees are more problematic. Poor blood supply, difficulty keeping the wound clean, and the constant motion prevent easy wound care.

b. **Medicine**. In general, anything used to treat a wounded Soldier can be used for animal wounds. Medics should carry heavy weight sutures, medicated salve and several rolls of 4” vet wrap.

c. **Destroying Stock**. There are four main ways to destroy stock.

(1) Striking between the ears with a heavy blunt object. Make an imaginary x between the animals’ ears and eyes. Strike where they meet. Having the animal secured will greatly increase your chances of success.

(2) Cutting the throat on the lower 1/3 of the neck to sever the jugular vein.

(3) Shooting, make an imaginary x between the animals’ ears and eyes. Shoot from close range.

(4) Turn the animal loose. Let nature take its’ course. This is the least preferred option due to prolonged animal suffering and the animal may follow the herd.

Table of Contents

Notes:

18 - Rappelling in Mountainous Terrain

071E9011

INTRODUCTION: Operations in the mountains will often require Soldiers to move down steep, slippery or hazardous terrain. Rappelling allows Soldiers to negotiate this terrain effectively and in a safe manner. Understanding how to establish safe rappel points and move Soldiers down them quickly and efficiently allows units to move through restrictive terrain and gain the tactical advantage over the enemy.

a. Perform a hasty rappel.

(1) Face sideways to the anchor and place the rope across your back. Your elbows trap the rope over your back.

(2) The hand nearest to the anchor is your guide hand, and the other, your brake.

(3) Lean out 90' from the rock.

(4) To stop, bring your brake hand across your chest and turn toward the anchor. It is easier and faster than the other methods, especially when the rope is wet.

b. Perform a Body Rappel.

(1) Face the anchor and straddle the rope.

(2) Pull the rope from behind, run it around either hip, diagonally across the chest, over the shoulder and to the brake hand opposite the shoulder.

(3) Lead with the braking hand and face slightly sideways. Do not cross your feet. Keep the other hand on the rope above you as a guide, not a brake.

(4) Lean out at a 90-degree angle to the rock. Keep your legs spread and your back straight.

(5) Turn your collar up to prevent rope burns on the neck. Use articles of clothing as padding where needed.

(6) To brake, lean back, pivot on uphill foot, turn towards the anchor and bring downhill hand up and across the chest at the same time.

c. Perform a Seat Hip Rappel. This method has little friction and is fast. Keep loose clothing or equipment away from the carabiner.

(1) Face the anchor.

(2) If right handed, stand with the rope to your right. If left handed, then to the left.

(3) Take slack from the anchor side. Bring the ropes around the spine of the carabiner (forming a round turn) and place them into the gate. If a single rope is used, repeat to place two round turns around the spine.

(4) Ensure the rope is snapped in correctly or the results could be fatal.

(5) Facing sideways, descend using your upper hand as the guide and the lower as the brake.

(6) Grasp the rope by the brake hand with the thumb pointing down and toward the body. Hold the brake hand behind and slightly above the hip.

(7) Brake by tightening your grip and pressing the rope against your body. Stay in an "L" shape body position and make a smooth descent.

d. Perform a Rappel Using a Rappel Device. This has more friction and is slower than using a carabiner. Keep fingers and loose clothing away from the rappel device.

(1) Place a locking carabiner through the waist and the leg connector strap of your harness.

(2) Face the anchor. If right-handed, stand with the rope to your right. If left-handed, then to the left.

Table of Contents

(3) Hold the rappel device with the slots toward you. Place a bight of rope through the slot.
(4) Attach the small hole or cable of the rappel device and the bight of rope into the locking carabiner.
(5) Descend by using your upper hand as the guide and the lower hand as the brake. Grasp the rope in your brake hand with your thumb pointing up and towards the device. Hold your brake hand slightly above the hip.
(6) Brake by closing your hand around the rope.
(7) Keep an "L" shaped body position. Make a smooth descent.

Note: Do not let the rope abrade the harness.

e. Perform a Rappel Extending the Rappel Device. There are times when the friction device needs to be further away from the body (rappelling with a self-belay).
(1) Girth hitch a piece of webbing correctly through the harness or place a double bight through the same area.
(2) At the end of this webbing, place a locking carabiner and the rappel device. The rappel device should remain within arm's reach.
(3) Place the rope correctly through the rappel device.

Note: Be extremely careful when rappelling over sharp projections. The extension on the friction device is especially vulnerable to abrasion.

Note: The extended rappel device may catch on the surface when going past an overhang. Pay close attention to avoid this.

f. Perform a Self-Belay Rappel (rappel device with a Self-Belay). Use A Self-Belay When A Bottom Belay Is Not Feasible.
(1) Girth hitch a piece of webbing correctly through the harness.
(2) At the end of this webbing, place a locking carabiner and a rappel device. The rappel device should remain within arm's reach.
(3) Place the rope correctly through the rappel device.
(4) Place a locking carabiner into the tie in portion of the harness.
(5) Place an auto block on both ropes and secure this into the locking carabiner in your harness (see figure 5).
(6) Make sure that the auto block cannot touch the rappel device when loaded.
(7) Feed the rope from below the rappel device with your guide hand. This may seem a little awkward at first, but with practice, it becomes quite efficient.

g. Perform a rappel bottom belay. Areas with Little Chance of Falling Rock (Fireman Belay).
(1) Assume a position at the base of the lane, approximately one pace away from the wall.
(2) Ensure that there is at least 10 feet of rope on the ground.
(3) Grasp the rappel ropes with both hands. You should be able to stop the rappeller quickly, but your grip should not impede him.
(4) If the rappeller yells "Falling," immediately stop the rappeller by pulling downward on the rappel ropes.
(5) Do not wear gloves unless otherwise directed by the Safety OIC/NCOIC. Wear gloves only if weather conditions warrant.
(6) Focus your attention on the rappeller at all times and maintain constant visual and audible contact.

Table of Contents

(7) Wear a helmet to prevent injuries from falling objects.

(8) Give all commands loud and clear. Do not look up or down if "ROCK" is yelled. Look directly into the cliff.

h. **Perform Proper Rappelling Commands.**

(1) Communication. Soldiers at the top of a rappel must be able to communicate with those at the bottom.

Rappeller	Belayer	Meaning
Lane (number), on rappel		The rappeller has been inspected and is ready to rappel.
	Lane (number), on belay.	The belayer has both hands on the rope and is ready to belay.
"Rock/Ice"		The belayer looks directly into the cliff. Do not look up.
"Falling"		The belayer pulls down on both ropes to stop the rappeller from falling further.
Lane (number), off rappel		The rappeller is safe and all equipment is off the rope.
	Lane (number), off belay.	The belayer is no longer holding onto the rope.

(2) Tactical. Consider radios, hand signals and rope signals. One person on the top of the lane can feel when the rope is unweighted in order to hook up the next rappeller. The use of one belayer for the entire element will eliminate confusion and commands.

Hasty Rappel

Body Rappel

Seat Hip Rappel

Extended Device

Table of Contents

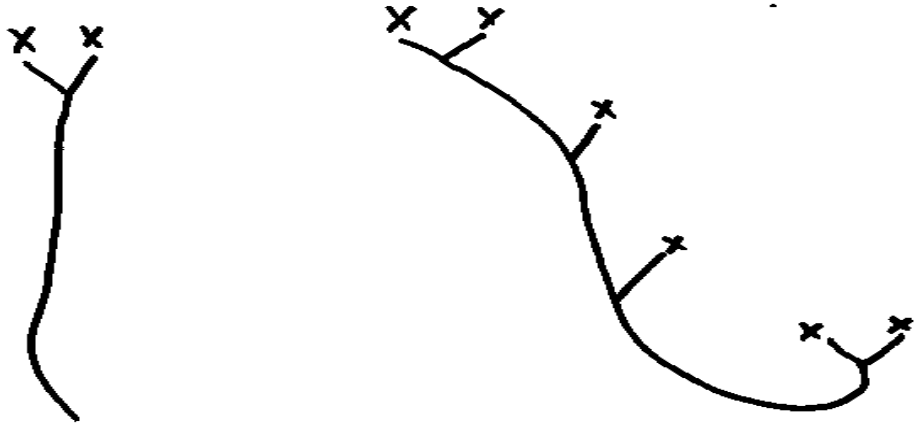
Notes:

19 - Fixed Ropes
071E9019

INTRODUCTION: Fixed ropes allow Soldiers to access restrictive terrain in order to gain the tactical advantage over the enemy. Units that can quickly install and efficiently move across fixed ropes can use this terrain to establish observation posts, support by fire positions, or emplace ambushes above the enemy. Every squad moving dismounted in the mountains should have the equipment and ability to establish and negotiate fixed ropes as a core mobility task.

Identify types of fixed ropes.

a. **Simple Fixed Rope**. A Simple fixed rope is a single line secured at the top. Static ropes are preferred for this system. A knotted hand line, rappel lane or a Prusik ascent lane could be classified as simple fixed ropes.
b. **Fixed Rope with Intermediate Anchors.** A fixed rope with Intermediate Anchors is secured at both ends and at intermediate points along the route.



Simple Fixed Rope **Fixed Rope with Intermediate Anchors**

Install a fixed rope with intermediate anchors (Starting From the Top).
a. **Route Requirements**.
(1) Suitable routing to avoid obstacles and make travel as easy as possible.
(2) Availability of anchors (natural & artificial).
(3) Protected route (from rock, icefall and potential avalanches).
(4) METT-TC.
(5) The route must have safe loading and unloading platforms.

Table of Contents

b. **Top Down Fixed Rope with Intermediate Anchors.**

(1) The installer must find a way to safely reach the top. Some options are:

(a) Use a fixed rope previously established by a trained assault climber.

(b) If the route is safe, climb it without rucksack while trailing the installation rope, installation will be attached to the installer.

(2) On the top of the cliff or slope, build a suitable anchor and secure the top end of the installation rope.

(3) Descend the route using the method most appropriate for the terrain.

(a) Use the rope as a hand line on moderated terrain.

(b) Hasty or Body rappel on Class 3 and 4 terrain.

(c) Rig an extended rappel device with an auto block self-belay on Class 5 terrain.

(4) During the descent, establish intermediate multi-directional anchors and secure the installation rope using each of the following:

(a) Double figure eight.

(b) Middle of the rope clove hitch.

(c) Prusik

(5) Secure the rope to the bottom anchor.

c. **Maintenance Responsibilities.** The installing unit is responsible for maintaining the fixed rope, policing the route, inspecting anchor points and protecting the rope with padding. The using unit will report any discrepancies they note to the installing unit for immediate correction. Complete daily maintenance checks on the installation during periods of low traffic volume. If the traffic volume is high, inspect/service more frequently.

Install a fixed rope with intermediate anchors (Starting From the Bottom).

a. **Route Requirements.**

(1) Suitable routing to avoid obstacles and make travel as easy as possible.

(2) Availability of anchors (natural & artificial).

(3) Protected route (from rock, icefall and potential avalanches).

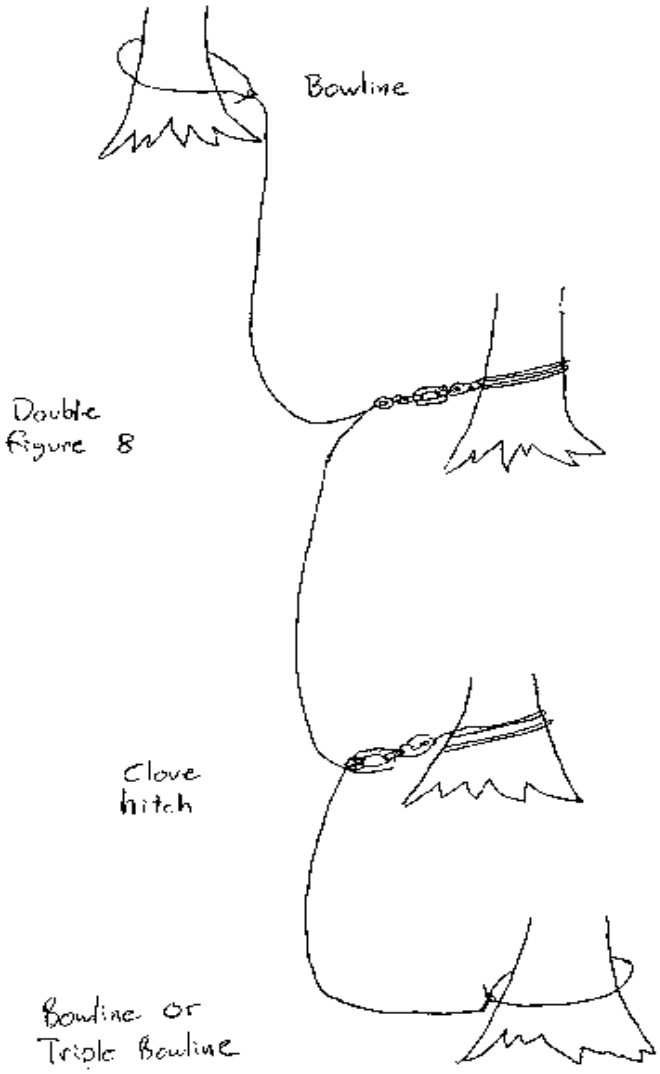
(4) METT-TC.

(5) The route must have safe loading and unloading platforms.

b. **Bottom up fixed ropes with intermediate anchors installation**. (3rd and 4th Class terrain only)

(1) The installation rope is back stacked with the bottom end anchored and the top end secured to the Soldier.

(2) The Soldier climbs the route trailing the installation rope, builds an anchor and proceeds to construct a top down fixed rope (reference learning step 1).



Fixed Rope with Intermediate Anchors

i. **Maintenance Responsibilities.** Inspect anchor points routinely. The using unit will report any discrepancies they note to the maintaining unit for correction. Complete daily maintenance checks on the installation during periods of low traffic volume. If the traffic volume is high, inspect/service more frequently.

Move on fixed ropes.

a. **Movement.** The number of independent sections built into the fixed rope limits the number of Soldiers that can travel safely. An independent section is a section of rope that has intermediate anchors at both ends. Table of Contents

b. **Equipment Requirements.** Determine the type and amount of equipment needed for fixed rope travel by considering the following:

(1) Type of fixed rope used.
(2) Terrain.
(3) Soldier's prior mountaineering training.
(4) Soldiers load.

c. **Communications.** It is imperative for Soldiers to use proper communication while moving on a fixed rope. Only one Soldier at a time will move on a simple fixed rope. When a Soldier clears an independent section while moving on a fixed rope with intermediate anchors, he must inform the next Soldier (either above or below) that he is clear.

d. **Methods.**

(1) *Hand over Hand.*
(a) The hand over hand method is the simplest to use and requires no equipment.
(b) This technique is limited to moving over simple fixed ropes on easy terrain where a fall would not be life threatening.

(2) *Double Headed Safety.*
(a) The double-headed safety method is the simplest method to travel over a fixed rope with intermediate anchors. This method involves having a rope tied around the waist two safeties at full arm's length with a single non-locking carabiner in each. Keep the two carabiners attached to the rope at all times unless moving past an intermediate anchor.
(b) To move past an intermediate anchor, clip one carabiner at a time above the anchor. When both carabiners are above the anchor, continue movement.
(c) A fall while traveling on this setup will be stopped by reaching the anchor below you. Do not use this method when a hard fall could occur.
(d) Tie a square knot around the waist above the hips, tie a figure eight knot at the end of the tails within arms' reach and insert a non-locking carabiner in the fixed loop of the figure eight.

Table of Contents

Equipment Needed:
1 – 18 ft sling rope.
2 - Non-locking carabiners.

Double-Headed Safety

(3) *Two Carabiner Method.*

(a) The two-carabiner method is used while wearing a harness. This method utilizes two pieces of tubular webbing: Girth hitched into the harness with a carabiner in each within arms reach. Keep the two carabiners attached to the rope at all times unless moving past an intermediate anchor.

(b) To move past an intermediate anchor, clip one carabiner at a time above the anchor. When both carabiners are above the anchor, continue movement.

(c) A fall while traveling on this setup will be stopped by reaching the anchor below you. Do not use this method when a hard fall could occur.

Two Carabiner Method

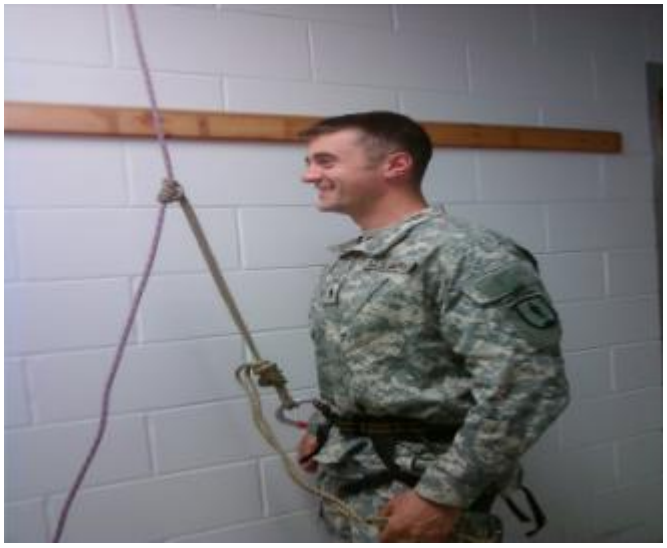
Equipment Needed:
1 - Harness or material for an improvised harness.
2 - 1 X 24 inch tubular webbing.
2 - Non-locking carabiners.

(4) *Single Prusik Method.*

(a) Use the single Prusik method to move over lower angled terrain on simple fixed ropes. To use this technique use one three-wrap Prusik with a double-double figure eight attached to a locking carabiner at full arms length.

(b) Use the single Prusik method to move over Simple Fixed ropes where a fall is likely. This technique uses a Prusik with a double-double figure eight attached to a locking carabiner and one safety with a non-locking carabiner, both at full arm's length. Keep the Prusik above the carabiner while you move so the carabiner will not make contact with the knot and possibly move it.

Table of Contents



Equipment Needed:
1 - Harness or material for an improvised harness.
1 - Locking carabiner.
1 - 15 ft utility cord.

Single Prusik Method

(5) Ascender-Carabiner Method.

(a) The ascender-carabiner method is the fastest way to travel up vertical and near vertical terrain. The setup includes one ascender and one safety with carabiner. Both are at full arm's length. While traveling, the carabiner is below the ascender until an intermediate anchor is reached.

(b) To move past the intermediate anchor, clip the carabiner above the anchor on the fixed rope and then move the ascender above the carabiner on the fixed rope.

Equipment Needed:
1 - Harness or material for an improvised harness.
1 - Ascender.
3 - 1 X 24 inch runners.
1 - Non-locking carabiner.
1- Locker

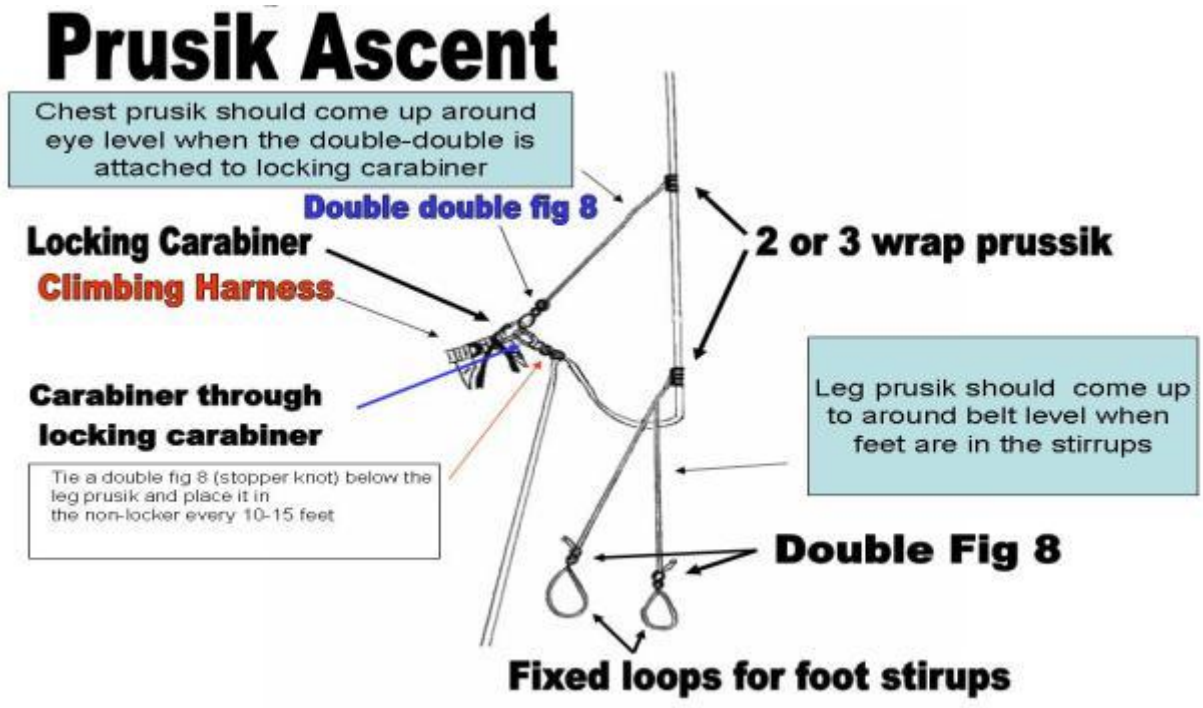
Table of Contents **Ascender-Carabiner Method**

(6) *Prusik Ascent.* Use the Prusik ascent system to ascend simple fixed ropes in steep or overhanging terrain.

(a) Tie a middle of the rope Prusik with a 7mm utility cord on the climbing rope.
(b) No more than arm's length away, tie a doubled double figure eight.
(c) Insert a locking carabiner into the tie-in portion of the harness.
(d) Insert the doubled double figure eight into the locking carabiner.
(e) Tie the second middle of the rope Prusik on the rope below the first Prusik.
(f) Tie a figure of eight within 6 inches from the Prusik. From the double figure of eight, run each running end to each foot.
(g) Tie a fixed loop in each end. If the loop is too large, keep the fixed loops snug around your foot with an additional figure 8 slip below the double figure 8 knot. The best length for the leg Prusik is to have the Prusik at waist level, with your feet in the fixed loops. Be especially careful when wearing crampons not to cut the cords.
(h) Attach a non-locking carabiner into the locking carabiner that is in the harness.

Note: Tying the Prusik ascent system while wearing the improvised climbing harness is the same as with a commercial harness.

Prusik Ascent Rigging



Equipment Needed:	
1	Harness or material for an improvised harness.
2	7mm X 15 foot cords.
3	Non-locking carabiners.
1	Locking carabiner.
2	24 inch tubular webbing.

a. **Ascending.**

(1) Slide the top Prusik up the rope as far as possible.
(2) Place all of your weight on the top Prusik by slowly leaning back.
(3) Lift your legs as high as possible and slide the leg Prusik up to the top Prusik.
(4) Stand up on the leg Prusik stirrups and repeat the process.
(5)For safety, tie a double figure eight in the climbing rope below the leg Prusik. Clip the figure eight into the non-locking carabiner that is in the locking carabiner in the harness tie in point.
(6) Approximately every 10 feet, tie another figure eight knot and replace the previously tied one in the non-locking carabiner. Be sure to clip in the new double figure eight before taking the old one out.
(7) Untie the old figure of eight knot.

b. **Overhangs.** This procedure is difficult because your body is pressing the rope against the steep face. If there are no handholds or footholds, pass the prusiks over the lip of the overhang by pulling out and sliding up at the same time or by tying a new Prusik above the lip, attaching to you and removing the original lead Prusik from the main climbing rope. If the lip of the overhang is not uniformly horizontal, it may be possible to slide the rope to the side where the lip is highest. Then the knot is moved up to the high point of the lip. When the knot is moved back towards the lower part of the lip the knot will be above the lip. If this does not work, it may be possible to get a shoulder between the rope and the steep face and get the knot above the lip.

c. **Rucksack Removal.**

(1) Girth hitch a piece of webbing through a load-bearing portion of your pack frame to pre-rig your ruck.
(2) Attach a carabiner to the webbing.
(3) To discard the rucksack, attach the girth hitched piece of webbing to the rope below your prusiks. Then remove the rucksack slowly and let it hang.
(4) Pull up the rucksack after completing the climb.

Note: (a) The end of the rope must be attached to the Soldier to use this technique.
(b) These procedures can be rough on the hands and you should have gloves available.
(c) Prusik up static ropes to avoid the stretch of dynamic ropes.

Table of Contents

Notes:

20 - Water Procurement

071E9030

INTRODUCTION: Keeping Soldiers hydrated in the mountains is a leadership challenge. The sense of thirst is dulled by high elevations despite the greater threat of dehydration. For extended missions, procuring and treating water from the environment may be necessary in order to maintain hydration and accomplish missions. Possessing the knowledge and equipment to collect and treat water is a vital part of preventing dehydration and illness while reducing a Soldiers load allowing increased mobility.

Identify Biological Contaminants.

a. Virtually all surface waters are microbiologically contaminated. There are three types of disease-causing microorganisms: protozoa, bacteria, and viruses. A 1992 study found that 97% of U.S. rivers and lakes contain one or both of the protozoan parasites giardia and cryptosporidium. Since microorganisms are impossible to see, you are taking a chance of getting sick every time you sip straight from a stream or lake.

b. Protozoa: Protozoa are the largest of the waterborne bugs measuring in the one-micron range. Giardia and cryptosporidium are the most infamous of the group. The infective cysts and oocysts of protozoa are extremely robust and can survive for months in a water source. They thrive in domestic and wild animals as well as humans. Cryptosporidia oocysts are known for their resistance to chemical treatment. Most disinfectants are ineffective, and the few that are require long dwell times to do the job.

c. Bacteria: Bacteria are an order of magnitude smaller than protozoa measuring in the 0.2-micron range. The most well known bacteria are E. coli; others include Campylobacter, Salmonella, and Shigella. Bacteria are not as hearty, surviving in water only for weeks instead of months. However, unlike protozoa and viruses, which require a host to multiply, some bacteria can grow in water and so can be found in higher numbers than protozoa and viruses. Bacteria, like protozoa, are often carried by both animals and humans. Because of this, many water sources are contaminated with bacteria. Beware especially of sources near agricultural operations.

d. Viruses: Some notorious waterborne viruses are poliovirus, hepatitis, and Norwalk. Currently, poliovirus only occurs in a few of the poorest countries. Waterborne viruses are very resilient and can survive for months in water. Viruses are generally species-specific; in other words, those that infect animals do not infect humans and vice versa. Because of this and the well-maintained sewage systems in developed countries, not as many water sources are contaminated with viruses. In developing countries with little or no sewage control, the opposite is true. However, as more and more people head for the great outdoors, more rivers, lakes and streams are at risk of viral contamination.

Identify Chemical Contaminants.

Filters and purifiers provide microbiologically safe drinking water. The carbon in the filters and disinfectant of the purifiers will adsorb or react with chemical contaminates such as herbicides, pesticides, and volatile organic compounds (VOCs). However, filters or purifiers will not protect you from high chemical concentrations or heavy metal contamination. Do your best to avoid water sources such as mining tailing ponds or those near agricultural operations.

Identify Treatment Techniques.

a. Filters work by physically removing infectious agents from the water. The organisms vary tremendously in size, from large parasitic cysts (Giardia and Entamoeba histolytica 5-30 µm), to smaller bacteria (E. coli 0.5 x 3 µm, Campylobacter 0.2 x 2 µm), to the smallest viruses (0.03 µm). Thus, how well filters work depends largely on the physical size of the pores in the filter medium. Table of Contents

b. Filters have the advantage of providing immediate access to drinking water without adding an unpleasant taste. However, they suffer from several disadvantages: micro cracks or eroded channels within the filter may allow passage of unfiltered water, they can become contaminated, and no filters sold for field use are fine enough to remove virus particles (Hepatitis A, rotavirus, Norwalk virus, poliovirus, and others).

c. In addition, they are expensive and bulky compared to iodine. Alas, many travel filters are inadequate even to reliably remove E. coli, the most common infectious

d. How to use a water filter

(1) Connect open end of Inlet Hose to Inlet Hose Barb.

(2) Before first use, pump 1-2 liters of water through filter (1-2 minutes) to purge residual carbon dust before attaching to a clean water container.

(3) Put Inlet Cage under water.

(4) Adjust Inlet Float to keep Inlet Cage between bottom sediments and water surface.

(5) Begin pumping until water enters Pump Head and flows out of Housing

(6) Place a clean container under the filter

(7) Begin pumping until water enters Pump Head, fills Housing, and begins to flow out of filter.

(8) Pump the Handle to filter water

(9) Packaging of a filter

(10) Remove Inlet Cage from water.

(11) Pump the Handle to purge filter of any remaining water.

(12) Rinse and air-dry Ceramic Element completely (3-5 days) before storage.

(13) Attach Clean Side Cover onto the bottom of the filter to prevent contamination.

(14) Wind Inlet Hose around Housing.

NOTE: There are many filters on the market become familiar with your model and its operation.

Identify Water Chemical Treatments.

a. Chemical disinfection of water depends on the killing of bacteria, Giardia and amoeba cysts, and viruses by the chemical. Halogens (chlorine and iodine) are most commonly used. The important points are that the killing effectiveness of the chemical is dependant on concentration of the chemical, temperature of the water, and contact time. Decreased concentration (better flavor) or decreased temperature (inevitably the case in the mountains) requires a longer contact time for disinfection. Sediment (cloudy water) increases the need for halogen. Bear in mind that adding flavor crystals to your water will use up the halogen and should only be done AFTER the recommended contact time for disinfection. Remember: "Add Flavor Later."

(1) Chlorine has been used for several centuries for water disinfection. The most common objection to it is the flavor, though there have been some suggestions that it is unreliable in killing Giardia cysts in the commonly used concentrations.

(2) Halazone tablets are convenient and inexpensive, but have several disadvantages. Due to its chemical formulation, reliable disinfection in all conditions requires six tablets per liter for 1-hour contact, resulting in poor flavor (Backer 1995). The tablets rapidly lose effectiveness when exposed to warm, humid air.

(3) Superchlorination-dechlorination - a two-step method is somewhat inconvenient, and the chemicals needed are destructive to clothing and gear if spilled, but it is highly effective and results in nearly flavorless water. High concentrations of chlorine are initially developed, and then in a second step removed by the addition of peroxide.

(4) Iodine has been used to disinfect water for nearly a century. It has advantages over chlorine in convenience and probably efficacy; many Soldiers find the taste less offensive as well. It appears safe for short and intermediate length use (3-6 months), but questions remain

about its safety in long-term usage. It should not be used by persons with allergy to iodine, persons with active thyroid disease, or pregnant women. If issued iodine treatment tablets are not available, 10% Povidone-Iodine (Betadine®) can be used in the concentration 4 drops/liter.

> **NOTE:** Iodine and other halogens appear to be relatively ineffective at killing cyclospora, a troublesome diarrhea-causing bacteria seen in Nepal only in the late Spring and Summer months. At these times it may be reasonable to pre-filter water to remove the large cyclospora (about the size of Giardia cysts), and then treating with iodine.

Use Heat to Treat Contaminated Water.
Heat kills microorganisms, and virtually all enteropathogens are readily killed at temperatures well below the boiling point. The process of heating water to a boil makes it hot enough long enough to disinfect it, even at elevations as high as Everest Base Camp (references 1, 2). There is no need to boil water for 5 minutes, 10 minutes, or 20 minutes, as some guidebooks recommend! Bringing water to a boil is adequate for disinfection.

Identify Field Expedient Water Sources from Moving Water.
Select a site that is not downstream from a settlement or heavily used farmland. Look for the clearest water possible. When operating in a glaciated area be aware of using glacial run off this can contain very fine slit that will clog filters. Even when treated, sediment will cause you to get sick.

Identify Field Expedient Water Sources from Standing Water.
Search for water that is clear and free of sediment and algae. Avoid collecting water from the bottom of this type of site to cut down on the amount of foreign matter in the water.

Identify Field Expedient Water Sources from Snow and Ice.
Look for clean white snow. When setting up camp mark off a place that every one will collect snow for melting to help avoid accidental contamination of the site. You will still need to bring the water to a boil to purify it because many microorganisms can survive in a frozen state. Avoid discolored snow that has obvious contaminants – i.e. yellow snow.

Perform Techniques to Avoid Cross Contamination.
Collection container needs to be different from the storage container. Cross contamination is a large concern with filters because they only filter the water, not the container.

Perform Techniques for Proper Container Selection.
Storage containers should be clean and tight sealing and able to hold boiling water. You should have enough storage space to hold a days worth of treated water. Wide mouth openings are easier to fill with boiling water.

Table of Contents

Notes:

21 - Climbing Techniques
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INTRODUCTION: Military mountaineering provides access to otherwise inaccessible mountainous terrain. Soldiers skilled in mountaineering techniques can accomplish essential missions in difficult terrain. They can serve as guides, observers, snipers, scouts, security elements and assault team members. It is important to be able to climb steep rock faces safely while using maintaining economy of motion. The objective is to get to the top of the steep terrain using as little energy as possible.

Concept of a Top Rope Belayed System.

a. A Top Rope Belayed system is one in which both rope ends are on the ground and the rope runs up to the top of the cliff or climb and passes through carabiners in a pre-established anchor point. This enables one Soldier to climb while the other Soldier takes in rope via a mechanical belay in order to keep the rope tight in the event of a fall. This system also enables the belayer to lower the climber back down to the ground after completing the climb.

b. A Top Rope system is a training tool only. It allows Soldiers to learn the fundamentals of tying in and belaying in climbing and to practice individual climbing techniques without the consequences of a long leader fall or unroped fall on steep terrain. Also, practicing these skills on steep, challenging terrain will promote competence and confidence on relatively easier terrain.

Tying into a harness.

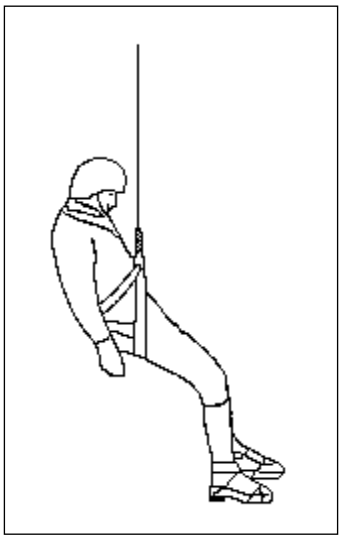


Figure 21-1
Waist Tie-In

a. A commercially manufactured Seat Harness or a field expedient harness or a field expedient seat harness is used during belayed climbing. There are many commercially manufactured harnesses available. A manufactured harness is more comfortable and easier to use than the field expedient harness. However, the material used for a field expedient harness may serve multiple functions for the Soldier. The preferred method of tying in to a harness is directly into the tie-in portion with a rerouted figure eight knot.

Table of Contents

Anchoring the belayer

a. Anchor the belayer to keep them from being pulled off their original stance when:
(1) There are inexperienced belayers
(2) The climber severely outweighs the belayer
(3) It is necessary to keep them from being pulled into hazards and obstructions

b. Anchor the belayer by attaching sling or cordellete from the anchor directly to the tie-in portion of the harness.

Belaying the Climber - Ensure you have a good stance with feet approximately shoulder width apart. Pull down the rope opposite the climber until it is tight with the climber's harness.

a. Belaying with a Munter Hitch.
(1) Place a pearbabiner into the tie-in portion of the harness. Tie a Munter hitch in the climbing rope and clip it into the pearabiner for either a right hand or a left hand brake. Lock the pearabiner.
(2) To take in rope grasp the brake strand with your brake hand a few inches away from the Munter hitch and with your thumb pointed up. Pull down with your guide hand and up with your brake hand simultaneously until you brake hand is just below your guide hand. With your guide hand grasp both ropes just above your brake hand and then slide your brake hand back down to its original place a few inches from the Munter hitch.
(3) Reach back to the load rope with your guide hand and repeat.
(4) In the event of a fall the bight of the Munter hitch will pass from the brake side of the pearabiner to the guide hand side. The hitch creates enough friction for the belayer to easily hold the climber's body weight.
(5) The brake position for the Munter hitch is with the brake strand and the load strand parallel.
(6) Never let go of the brake rope. The climber's life depends on it.
(7) To lower the climber back down upon reaching the top place both hands on the brake strand of rope and feed rope slowly back through the Munter hitch until the climber is safely on the ground.

Note: Do not put your brake hand too close to the Munter hitch. The potential of getting your fingers caught in the Munter will cause you to lose control of the brake, dropping the climber.

b. Belaying with a tube style belay/rappel device (SBG, ATC, Reverso).
(1) Place a locking carabiner into the tie-in portion of the harness. Thread a bight of the climbing rope through the tube slot of the device opposite the side of the keeper loop. Attach both the bight of rope and the keeper loop to the carabiner and lock the gate.
(2) To take in rope grasp the brake strand a few inches from the device and with your thumbs pointed towards the device. Reach out and place your guide hand on the load rope with your thumb pointed up. Pull down with your guide hand and up with your brake hand simultaneously until your brake strand is approximately one foot away from your waist. Bring the brake rope immediately down below your waist (brake position). Move your guide hand down to the brake rope just underneath your brake hand and slide your brake hand back to within a few inches from the device. Reach back up to the load rope with your guide hand and repeat.

(3) The brake position with a tube style device is down thus creating two sharp bends in the rope that provide necessary friction.

(4) Never let go of the brake rope. The climber's life depends on it.

(5) To lower the climber back down upon reaching the top place both hands on the brake rope down in the brake position and feed rope slowly back through the device until the climber is safely on the ground.

Use Climbing Commands

a. Using standardized verbal climbing commands is a necessary safety protocol to ensure both members are ready before any actions are taken

b. Verbal Commands for Top Roping.

	Belayer	Climber	Comments
	"On Belay"		I've inspected my belay position and equipment. My brake hand is on and I will manage the rope as necessary. You may go ahead and climb.
		"Climbing"	I am beginning the climb
		"Slack"	Feed out rope in my direction
		Rock / Ice/ Falling	Intermediate commands. Use as needed.
		"Do you have me?" or "Have you got me?	Im at the top and ready to be lowered back down
	"I have you" or "I've got you"		Go ahead and weight the rope and I will begin lowering
		"Off Belay"	Only when safe
	"Belay Off"		

Table of Contents

Identify Fundamentals of Rock Climbing Movement.

a. General. Study the climb to make sure you select the best route and have the necessary equipment.

b. Visually Climb the Route. Visually climb the route first. This allows you to move efficiently and plan exactly how to use each hold.

c. Climbing in Balance. (Fig 21-2) Stand erect with your body weight directly over your feet. Use your hands for balance. Use your skeleton to support your weight. A beginner leans in and hugs the rock. An upright stance improves footing by developing maximum friction and balance.

Figure 21-2
Climbing in Balance

d. Descents. (Fig 21-3) Face out when the going is easy, sideways when hard or face in when difficult. Use the lowest possible hand holds.

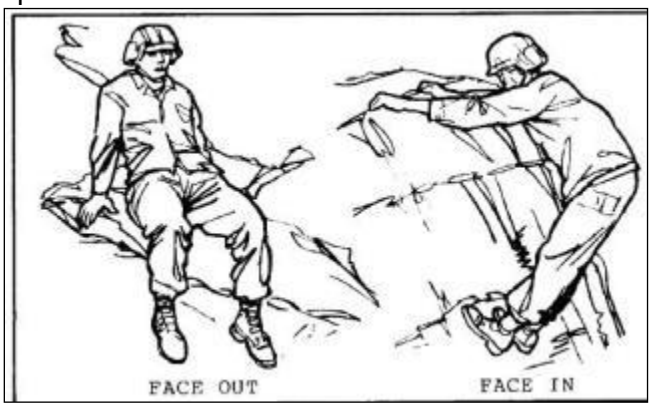


Figure 21-3
Descending

e. Three-points of Contact. Always maintain three points of support to enhance stability and security. Use two feet and one hand or one foot and two hands while the remaining limb moves to the next hold.

f. Controlled Motion. Move with economy of effort to avoid fatigue. Try to push up with the legs instead of pulling with the arms. The more you use your legs, the longer your arms will last. Keeping hands at head level saves arm strength and permits you to lean away from the rock to see holds (extremely important when down-climbing steep rock). Avoid excessively high steps or long reaches. Use intermediate holds when available. Jumping to reach a hold can be a disaster. You may miss the hold; it may be loose or illusionary. Try to press down rather than pull up. Seek natural body positions, rather than awkward, tiring ones.

g. Actions if Falling. Sound the command "falling." Do NOT grab the rope. Push yourself away from the rock and keep your hands out toward the rock to protect yourself.

j. Movement on Slabs. Precise friction and balance are the only means of staying on the rock.

Identify the Types and Use of rock climbing holds.

a. Use of Holds. Choose holds for stability, convenience and size. If questionable, test with a blow from the hand or foot. Avoid using knees and elbows because they are easy to injure and offer very little stability. You can use the "change step" when traversing (hop with one foot and replace it quickly with the other). You should test all holds by applying weight gradually. Most handhold become footholds as you move up the rock. There are six basic holds.

(1) Push Holds. (Fig 21-4) Push holds are pushed down upon and help the climber keep his arms low, but are more difficult to hold onto in case of a slip. They are often used in combination with a pull hold.

Side Pressure Downward Pressure

Figure 21-4
Push Holds

Table of Contents

(2) Pull Holds. (Fig 21-5) Pull holds are those pulled down on and are the easiest holds to use. They are also the most likely to break. This is the most commonly sought handhold. The climber grasps the edge of a crack; corner or knob then leans slightly away from the hold while stepping upward. On small holds, the fingers form to fit the rock. A larger hold, preferably sloping inward, becomes a true handhold for the entire hand. The best and most comfortable of these are referred to as "jugs".

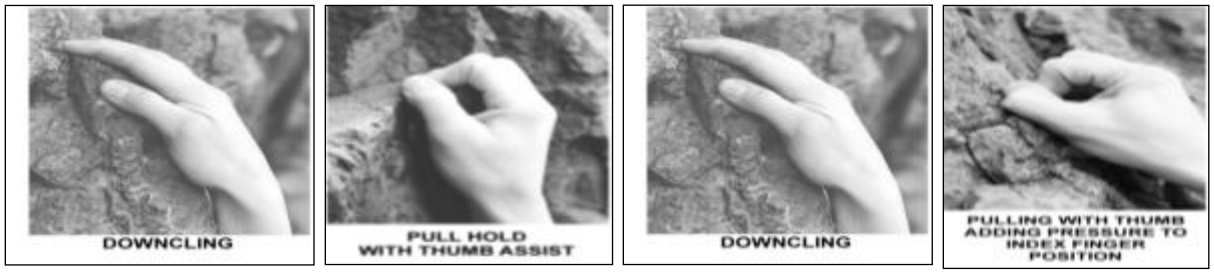


Figure 21-5
Pull Holds

(3) Foot Holds. (Fig 21-6) On steep slopes, keep your body vertical; make use of small irregularities in the slope to aid friction. Footholds less than 1 ½ cm wide may be sufficient for intermediate holds, even when they slope out. Footwork in rock climbing is essential. Place feet carefully in the desired position and do not move them. Do not thrash about in hopes of finding something better. With marginal footholds it is mandatory not to rotate or move your foot once it is in place. Even a small change in position may cause your boot to slip. If wearing stiff boots, turn the foot sideways to get the stronger inside edge of the boot and foot on the hold. In very flexible boots or rock shoes, the foot may have to point uphill with the boot sole "smeared" or "covering" the small hold. If muscles are under too much strain for too long a time the leg may begin to vibrate. "Sewing machine leg" can be very annoying and dangerous. The best way to stop this vibrating is to change position by moving on, lowering the heel or straightening the leg.

Minimal Sole Contact (Poor) Maximum Sole Contact (Best)

Figure 21-6
Foot Holds

(4) Friction Holds. (Fig 21-7) Friction holds are solely dependent on the friction of hands or feet against a relatively smooth surface with shallow holds. They are difficult to use because they give a feeling of insecurity. The inexperienced climber tries to correct this by leaning closer to the rock. This movement actually increases his insecurity. They often serve well as intermediate holds. Some give needed support during movement to another hold, but would not hold if you stopped.

Figure 21-7
Friction Holds

(5) Jams. (Fig 21-8) Jamming is wedging fingers, hands, arms, feet, knees, legs and/or any other portion of the body into cracks and lodging them securely enough to bear weight. Jamming or crack climbing is less instinctive, but often more secure than other types of holds. Each movement should be very deliberate. Thrashing about and desperate pawing at the rock are useless and tiring. Before moving a hand or foot, look ahead, select a prospective place, then move the hand or foot to the new jam position and lock it in place. Cracks come in all sizes, from narrow to wide.

Fist Jam

Hand Jam

Fist Jam

Hand Jam, Thumb Down

Finger Jam, Fingers Cammed/Locked

Figure 21-8
Jam Holds

(6) Combination Holds. The holds previously mentioned are considered basic and from these you can use any number of combinations and variations.

(a) Chimney Technique. (Fig 21-9) The chimney climbing technique exerts cross pressure between the back and the feet, hands or knees. Insert the entire body into a crack in the rock. By using both sides of the opening and possibly all types of basic holds, move up the crack. These techniques rely on the friction maintained by cross pressure with the body. Maintain as many points of contact as possible.

Figure 21-9
Chimney Climbing

(b) Stemming. (Fig 21-10) Use the cross pressure of two hands, two feet, one hand and one-foot, etc. Stemming is most commonly used in corners and wide chimneys. This is a good resting position.

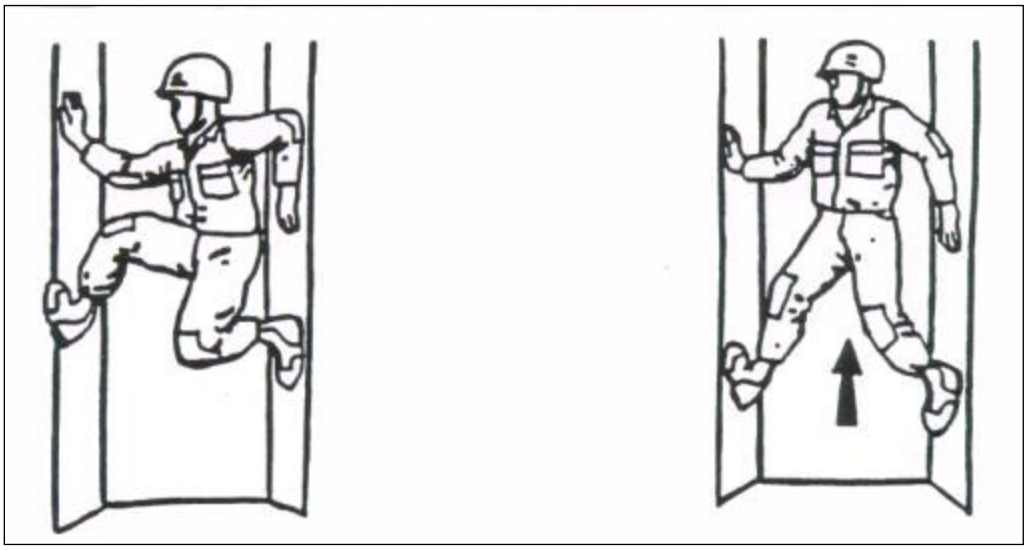


Figure 21-10
Stemming

(c) Lie Back. (Fig 21-11) A lie back is done by leaning to one side of an offset crack with the hands pulling and the feet pushing against the offset side.

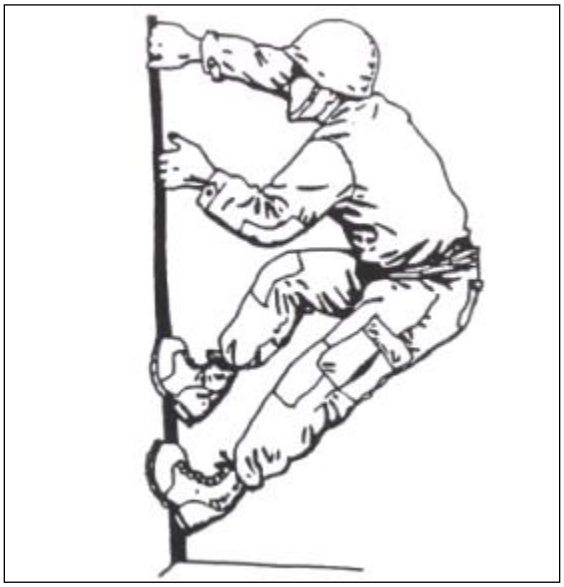


Figure 21-11
Lie Back

(d) Pinch Hold. (Fig 21-12) Pinch a rock protrusion between the thumb and fingers.

Table of Contents

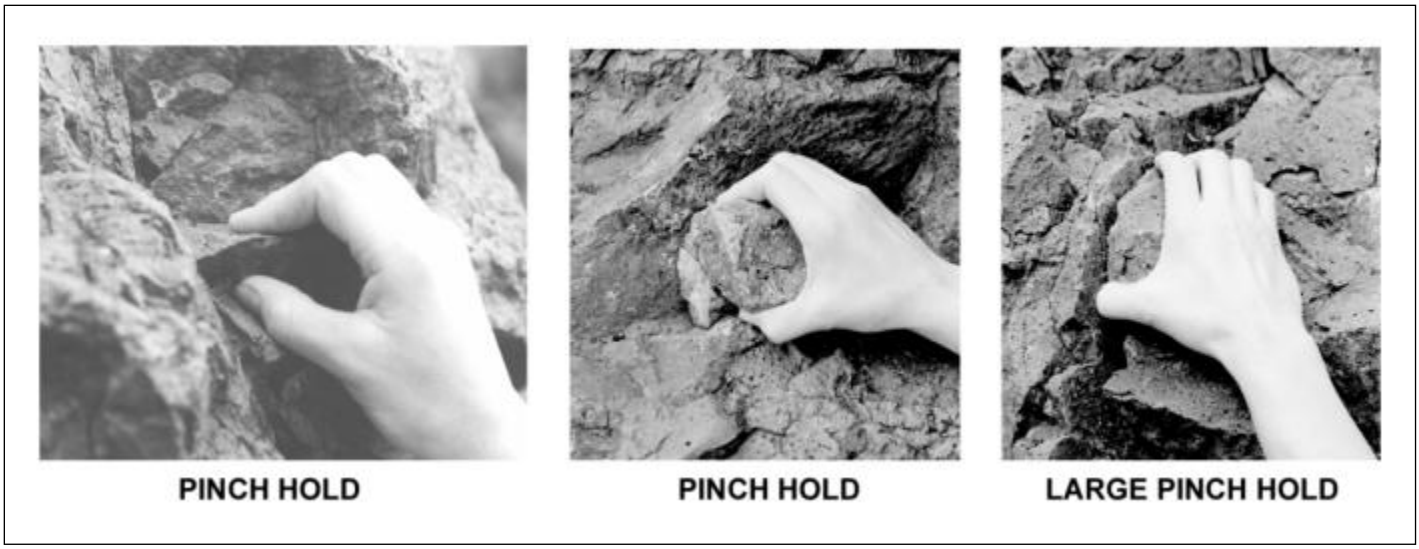


Figure 21-12
Pinch Hold

(e) Underclings. (Fig 21-13) Underclings allow opposing pressure between hands and feet.

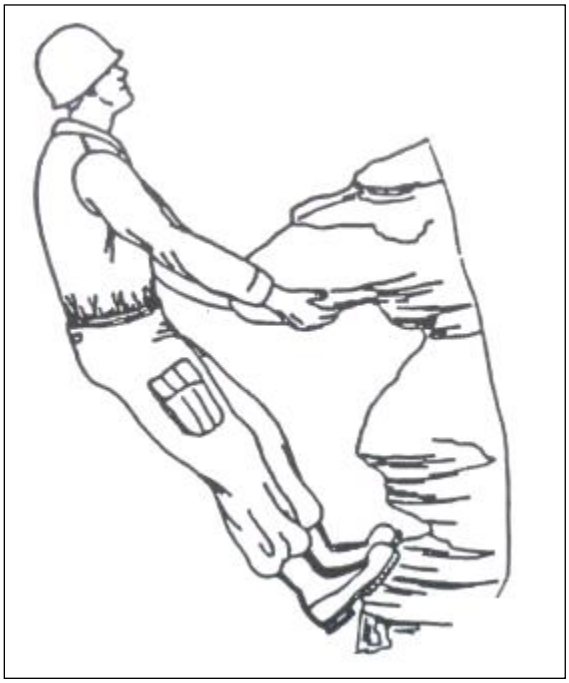


Figure 21-13
Underclings

Table of Contents

(f) Mantling. (Fig 21-14) Mantling is done by two push holds at once to raise the body onto a ledge when there are few available footholds. Try to use your legs as much as possible, to help the upper body.

Use pull holds until the arms are straight and the elbows can be locked	Work toes up the rock until the arms are extended
Bring one foot up, move one hand forward for balance, begin lifting the other foot	Maintain balance while placing other foot

Figure 21-14
Mantling

Table of Contents

Climbing on Snow and Ice.

a. Flatfooting with Crampons (French technique).

(1) Ascending.

(a) Cane Position.

- When walking on moderate surfaces of 0-15 degrees, widen your stance slightly more than normal walking to avoid snagging a crampon point.
- As the degree of angle increases on the slope, your feet are shifted outward to relieve stress on ankles and calves.
- When the slope gets steeper (moderate, 35-50 degrees) turn sideways so your feet face across the slope.

(b) Cross Body Position. (Fig 21-15)

- To take a step, lift the downhill (outside) foot in front of and above the uphill (inside) knee, into the "out-of-balance" position.
- Return to the "in-balance" position. Bring the lower (inside) foot up behind and place in front of the outside foot.
- Keep your body weight over your crampons.
- Plant the axe about an arm's length ahead of you each time before you move another two-steps.

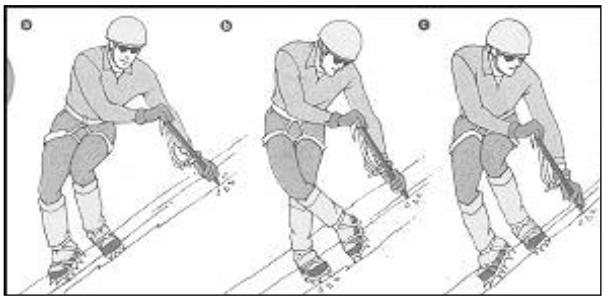


Figure 21-15
Cross Body Position

(c) Changing Direction. (Fig 21-16)

- From the position of balance, place the axe directly above your location.
- Move your downhill foot forward into the out of balance position, to the same elevation as the other foot pointing slightly uphill.
- Return to the in balance position by moving your foot that is still pointing in the original direction to above and in front of your other foot.

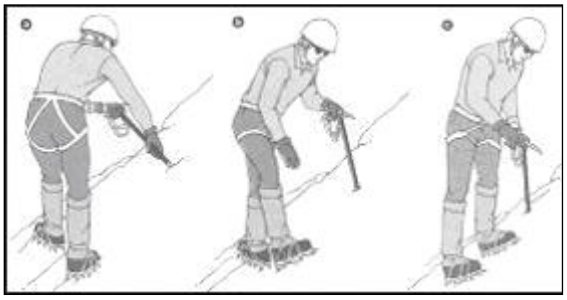


Figure 21-16
Changing Position

Table of Contents

(d) Anchor Position. (Fig 21-17)

- Grip the axe shaft near the spike with your outside hand. Swing the axe in a smooth arc engaging the pick above and slightly in front of your head.
- Keep the shaft parallel to the slope.
- With the other hand, take hold of the axe head in the self-arrest grasp.
- Pull down and step up to a new in-balance position. Maintain a gentle outward pressure to lock the axe in the ice by setting the teeth.

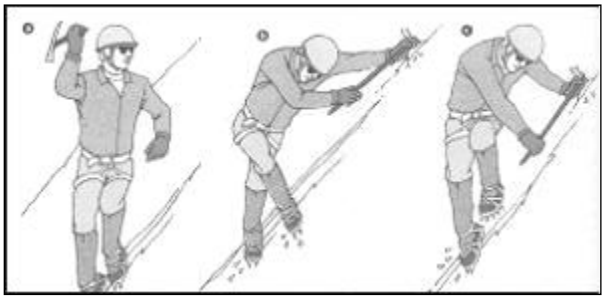


Figure 21-17
Anchor Position

(e) Foot Seat (in balance position). (Fig 21-18)

- Move the outside (lower) foot up and underneath the buttocks with the toes pointing straight down.
- Sit down on that foot.

Figure 21-18
Foot Seat

(2) Descending.

(a) Duck Walk (Cane, cross-body). (Fig 21-19)

- Point your toes downhill. Bend your knees. Hold your axe in the cane position.
- Splaying the feet out will relieve some strain on the calves and ankles when the angle of the slope increases.
- Hold the axe in the cross-body position for greater security.

(b) Flatfooting (Support position).

- As the slope increases, use the axe in the support position.
- Hold the shaft roughly parallel to the slope, pick uphill and spike downhill.
- Rest the pick tip and spike on the ice.

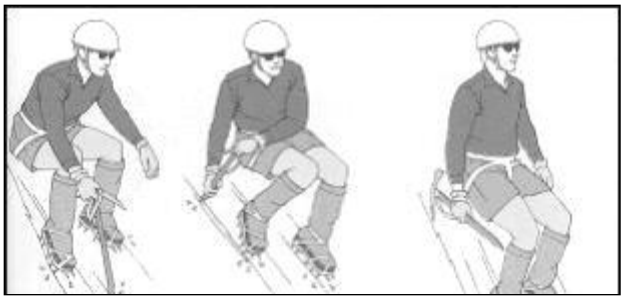


Figure 21-19
Duck Walk (Cane, cross body)

(c) Axe in the Banister Position. (Fig 21-20)

- From a position of balance, swing the axe downhill, setting the pick end as far below as possible.
- Pull outward gently to set the teeth. When you pass below and beyond your axe, push in on the axe to release the point. Repeat as you continue down.

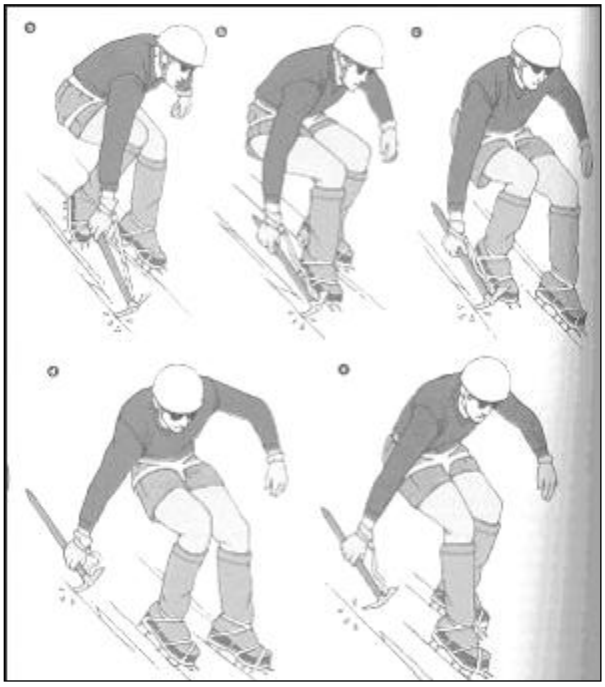


Figure 21-20
Descending (Axe in banister position)

(d) Descend diagonally (Axe in Anchor Position). (Fig 21-21)

- Turn your feet sideways and descend diagonally. Use the axe in the anchor position.
- The axe is swung using the outside hand swinging from the shoulder, setting the pick low and to the front.
- Rotate the shaft as you pass below it.

Figure 21-21
Descending Diagonally (Axe in anchor position)

Glissading. (Fig 21-22) Whenever possible, gentle, moderate and even some steep slopes should be descended by the glissade. Ideal snow for glissading is solid enough to provide support, but softened on the surface. If the surface is rough, there will be too much friction and you will not be able to slide effectively even on steep slopes.

a. Basic Glissade Methods: Standing, Crouching and Sitting.

(1) Standing Glissade. The technique is similar to skiing.

(a) The standing glissade is the hardest to learn.
(b) Keep your feet together with knees bent forward slightly to act as shock absorbers.
(c) Center your weight over the balls of your feet. If you rock too far forward you will trip.
(d) Center the weight on your heels to slow down.
(e) Adjust your body position in relation to the slope to keep your weight centered.
(f) You can slow down by rocking back on your heels and even stop by turning your feet sideways and skidding.
(g) Turning is the best speed control.
(h) Rotate the upper body, legs and feet, toward the desired new direction.
(i) Roll your knees and ankles toward the turn.
(j) This will angle your boots onto the edges and carve the turn.
(k) Unweighting will help on high-friction snow or low-angle slopes.
(l) Crouch-and-spring-up to unweight.
(m)You can sometimes turn on the downhill side of small bumps and let the terrain do the work.

(2) Crouching Glissade.

(a) Use the crouching glissade if the slope is too steep to do a standing glissade.
(b) This technique is glissading sitting on your heels to keep the center of gravity low and close to the snow.
(c) It gives good balance and means you do not have as far to fall or as awkward a position to recover from if you do fall.
(d) In a crouch you have much less control over turning and the foot brake is less effective.
(e) Your entire position is less dynamic and versatile.
(f) You can use the spike of the axe as a brake.
(g) Should you fall, you are closer to self-arrest.

(3) Sitting Glissade.

(a) Use a sitting glissade when the snow is too soft to slide on with your feet.
(b) Sit down on the snow slope.
(c) Use the spike of the ice axe as a rudder to control your speed.
(d) If self-arrest is needed, always roll towards the head of the ice axe.

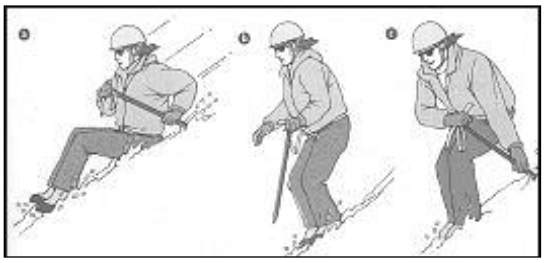


Figure 21-22
Glissading Techniques

b. Self Arrest. (Fig 21-23)

(1) With one hand, grip the head of the axe; hook that thumb under the adze.

(2) Grasp the shaft near the spike with your other hand.

(3) Hold the axe diagonally across your body with the adze away from your shoulder and the spike next to the opposite hip.

(4) You must force the pick of the axe into the slope to self-arrest.

(5) Force the pick into the snow with the axe head no higher than the top of your shoulder (if it is higher it will be hard to hang onto).

(6) Arch your body so that your weight is on your toes and the axe pick.

(7) Force your body to arch and bear down on the pick. If you forget, the spike will catch in the snow and wrench the axe out of your hands.

(8) Spread your feet for balance. You are stable on three points of support: the axe and both feet. If your feet are on the snow while you are wearing crampons you may flip over backwards. Use your knees instead of your feet if you are wearing crampons.

Figure 21-23
Self-Arrest

Demonstrate Steep Snow/Ice Climbing Techniques.

a. Front- Pointing With Crampons. The addition of two front points in 1932 made it possible to attempt pitches more than 70 degrees.

(1) Crampon Placement. (Fig 21-24)

(a) Trust your crampons the first few times you get on the ice, especially if the conditions are cold and brittle.
(b) It is not necessary to repeatedly kick your foot against the ice. Many beginners kick too many times for each foot placement. One or two firm well-placed kicks will do it.
(c) Set the foot quickly and then transfer the weight quick to it. So pick the best spot-an old pick hole, a flat or concave surface or tiny ledge and place your front points in it.
(d) Kick the spot aggressively and accurately once or twice to set the front points.
(e) Drop your heels to relax your calves and seat the secondary front points, giving a stable tripod. (f) When you are climbing thin ice or rock, set the front points on rock edges or in cracks when possible and hold your foot steady to keep the points from slipping.

Figure 21-24
Proper Vertical Crampon Placement

b. Ascending with an Axe. (Fig 21-25)

(1) Low Dagger Position.
(a) Hold the axe by the adze in the self-belay grip.
(b) Push the pick into the snow about waist high.

(2) High Dagger Position.
(a) Hold the axe in the self-arrest grip.
(b) Drive the pick into the snow (dagger-style) over your head.

(3) Front Pointing (Axe in the Anchor Position).
(a) Hold the axe near the spike and swing as high as possible.
(b) Ascend until you hold the adze in the anchor position.
(c) Continue to ascend until you hold the adze in the low dagger position.

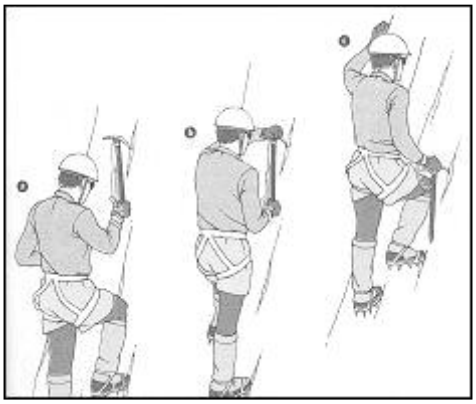


Figure 21-25
High and Low Dagger Positions

c. Ascending with two ice axes (Ice Tools). In 1966, a curve was added to the pick of a short handled ice axe. These made it possible to attempt ice over 90 degrees.

(1) Wrist Loop.

(a) Make the wrist leash loop large enough for the hand to fit through easily. This helps hold the hand in position on the axe.

(b) Attach the loop to the shaft above the correct hand position. This will keep the hand and shaft together whether or not the fingers are locked around the shaft. Using a wrist loop set up this way allows you to hang from an ice tool without fatiguing your forearms.

(2) Tool Placement. (Fig 21-26)

(a) Stagger your tool placements, instead of placing them side by side.

(b) Plant one tool, move both feet evenly, lock off on this tool and then advance the other tool.

(c) Move both feet again and reset the first tool.

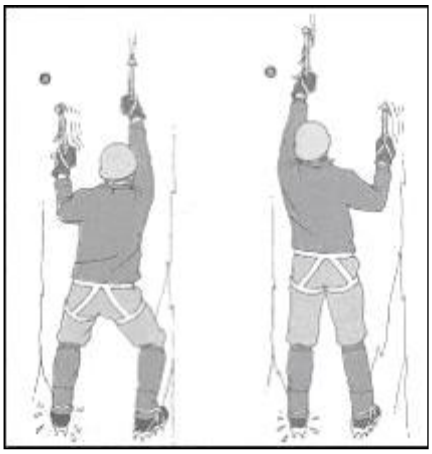


Figure 21-26
Vertical Tool Placements

Note: This way you make big, efficient moves on each tool placement and keep the picks spread apart so a fracture plate of ice cannot take out both picks.

(3) Body Position.

(a) Good body position will maximize the weight on your feet and conserve upper body strength.

(b) Keep your feet shoulder width apart or slightly less, to reduce the tendency to “barn door” to one side.

(c) Use several short steps, rather than high steeping, to reduce the stress on your quadriceps although high steeping can be necessary occasionally to get pass bulges.

(d) Always keep your weight over your feet.

(e) Trust your feet and move steadily and confidently.

(4) Removing a Stuck Tool.

(a) Try to remove it in the reverse of the motion used to set it.

(b) Loosen the placement by rocking the tool up and down.

(c) If this fails, release your grip on the tool and try to knock it loose by hitting up against the adze or hammer with the palm of your hand.

Note: Never remove a tool by moving it side to side because the pick may break.

Table of Contents

Notes:

22 - Additional Height Construction

071E9044

INTRODUCTION: Under certain situations, Soldier's must to have the capability of gaining additional height on their rope system in order to safely and effectively load or unload critical loads. The construction of a bipod or tripod may be necessary to make rope systems more effective and thus increasing a unit's capabilities.

Identify the equipment needed to construct a bipod.

a. **Bipod Equipment**. Construct a bipod large enough to allow sufficient clearance and strength for any intended load.

(1) You need two sturdy poles. The exact size of the poles depends on the type of load and location of the installation.

(2) Three or four 18-foot utility cords (the number depends on the diameter of the poles and the width of the finished bipod).

Note: The average size bipod pole should be at least 3 inches in diameter and 9 to 12 feet in length. Poles are stronger if they are fresh cut and green. Avoid dry poles as they are brittle and can snap under extreme loads.

Construct a bipod for additional height.

a. **Construction.**

(1) *Horizontal Wraps.*

(a) Place the two poles in position, as they would be in the finished installation and mark the apex on both poles.

(b) Make sure the bipod is high enough.

(c) A bipod out of proper alignment can cause a dangerous collapse of the system. Attempt to find natural pockets in which to place the base of the bipod poles.

(d) Place the poles side by side.

(e) Tie a clove hitch with a utility cord around the left pole, (standing at the base of the poles, facing the top) 3 inches above the apex marking.

(f) Leave 18 inches of pigtail.

(g) Place the locking bar on the outside edge of the pole. The 18-inch pigtail will exit to the left.

(h) Wrap the rope a minimum of six times horizontally around both poles, wrapping down from the clove hitch. All wraps will be made as tight as possible.

(i) It may be necessary to join another cord to the first by using a square knot secured with overhand knots. This knot will be positioned on the outside of one of the poles to not interfere with the vertical wraps made next.

(j) On the last horizontal wrap around the pole to which the clove hitch is not tied, pass the cord up between the poles.

Table of Contents

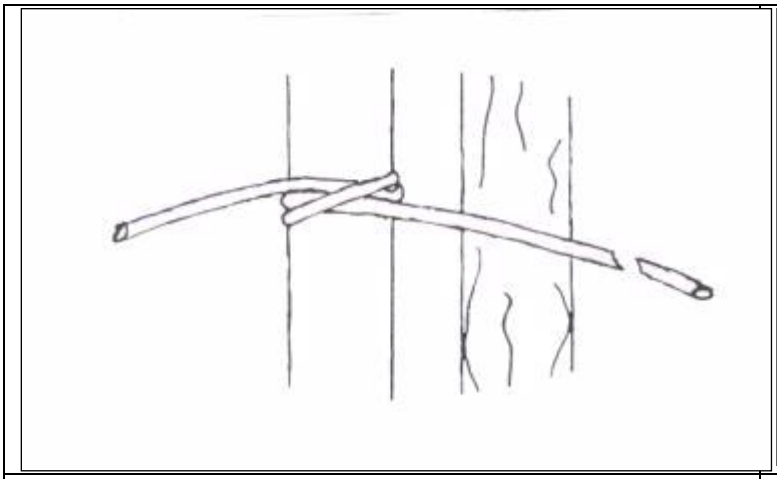


Figure 1
Initial Clove Hitch

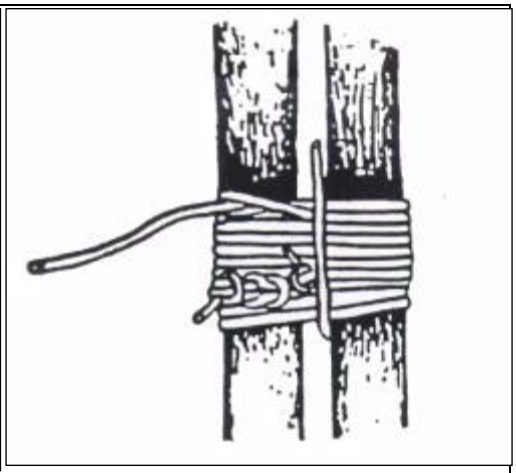


Figure 2
Initial Vertical Wrap

(2) *Vertical Wraps.*

(a) Lift the right pole and spread the legs to the finished width before wrapping.

(b) Make a minimum of four vertical wraps around the horizontal wraps.

(c) The wraps may cross each other to ensure tightness (See figure 3).

Note: Ensure you count wraps on both sides of poles. One side will have less than the other will.

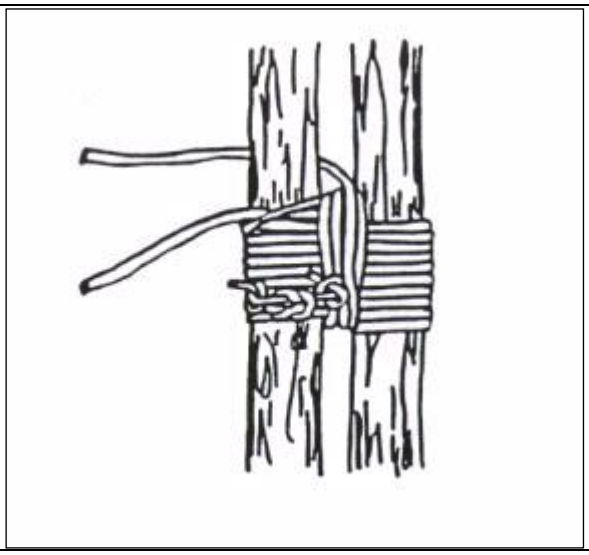


Figure 3
Last Wrap Before Square Knot

Figure 4
Apex Complete

(3) *Square Knot Tie-off.*

(a) On the last vertical wrap, pass the rope between the poles above the horizontal wraps.

(b) Tie it off with a square knot to the section of rope coming from the clove hitch.

(c) The ropes should be so tight that overhand knots cannot be used to secure the square knots in the normal manner. Use overhand knots tied in the tails (See figure 4)

Table of Contents

(4) **Spreader Rope**. A spreader rope is necessary to prevent the bipod from collapsing when pressure is applied at the apex.

(a) Tie a utility cord(s) as low as possible to both poles with a clove hitch and a bowline.

(b) If one utility cord is not long enough, join two cords together (See figure 5).

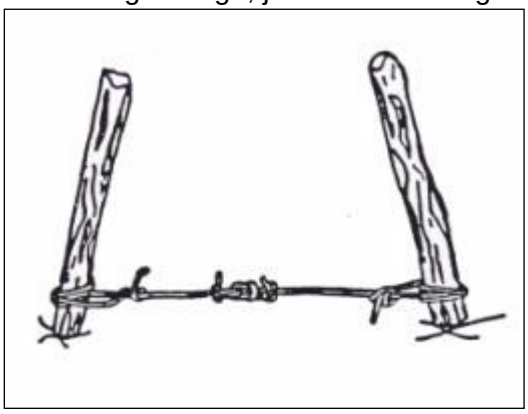


Figure 5
Spreader Rope

Identify the equipment needed to construct a tripod.

a. **Tripod Equipment**. Construct a tripod large enough to allow sufficient clearance and strength for any intended load.

(1) You need three sturdy poles. The exact size of the poles depends on the type of load and location of the installation.

(2) Three or four 18-foot utility cords (the number depends on the diameter of the poles and the footprint of the finished tripod).

Note: The average size tripod pole should be at least 3 inches in diameter and 9 to 12 feet in length. Poles are stronger if they are fresh cut and green. Avoid dry poles as they are brittle and can snap under extreme loads.

Construct a tripod for additional height.

a. **Construction.**

(1) *Horizontal Wraps.*

(a) Place the three poles in position, as they would be in the finished installation and mark the apex on both poles.

(b) Make sure the tripod is high enough.

(c) A tripod out of proper alignment can cause a dangerous collapse of the system. Attempt to find natural pockets in which to place the base of the tripod poles.

(d) Place 2 poles side by side.

(e) Tie a clove hitch with a utility cord around the left pole, (standing at the base of the poles, facing the top) 3 inches above the apex marking.

(f) Leave 18 inches of pigtail.

(g) Place the locking bar on the outside edge of the pole. The 18-inch pigtail will exit to the left.

(h) Wrap the sling rope a minimum of six times horizontally around both poles, wrapping down from the clove hitch. All wraps will be made as tight as possible.

(i) It may be necessary to join another cord to the first by using a square knot secured with overhand knots. This knot will be positioned on the outside of one of the poles to not interfere with the vertical wraps made next.

(j) On the last horizontal wrap around the pole to which the clove hitch is not tied, pass the cord up between the poles.

Table of Contents

(2) *Vertical Wraps.*

(a) Lift the right pole and spread the legs to the finished width before wrapping.

(b) Make a minimum of four vertical wraps around the horizontal wraps.

(c) The wraps may cross each other to ensure tightness (See figure 3).

Note: Ensure you count wraps on both sides of poles. One side will have less than the other will.

(3) *Half-hitch* around right pole and add a third pole wrap same way as steps one and two.

(4) *Tie off*

(a) On the last vertical wrap, pass the rope between the poles above the horizontal wraps.

(b) Tie it off with a square knot to the section of rope coming from the clove hitch.

(c) The ropes should be so tight that overhand knots cannot be used to secure the square knots in the normal manner. Use overhand knots tied in the tails (See figure 4).

Table of Contents

Notes:

23 - High Lines

071E9024

INTRODUCTION: A High Line allows a unit to safely cross water obstacles and steep ravines, as well as raise or lower personnel up or down vertical cliff faces. A properly constructed high line can save energy and time moving heavy items up, down or over rugged terrain. In an environment where the enemy has observation over known crossing sights and bridges, units that can construct high lines can achieve freedom of maneuver and seize the initiative.

Identify Safety Considerations.

a. **Soldiers.**

(1) Use no more than three Soldiers to tighten the rope. Using more personnel can over tighten the system and possibly cause failure.

(2) Keep personnel away from the edge until a safety rope is in place.

b. **Loading and Unloading Platforms**.

(1) Make sure that the loading and unloading platforms are free of loose material, no sharp edges are present and that they are large enough for high line operations.

(2) The loading / unloading platforms are easily accessible and provide a safe working area.

c. Anchors.

(1) Make sure that the anchors are available and suitable to handle large amounts of force created by the tightening system.

(2) Protect the ropes from abrasion.

d. Artificial Height.

(1) Bipod poles are sufficient size (diameter and length) to support the load and clear the loading/unloading platforms.

e. Belays.

(1) Use a relay man if the belayer cannot see the load the entire length of the system.

Identify Site Selection Criteria.

a. Anchor. Near and far anchor are available.

b. Loading and Unloading Platforms. Easily accessible platforms that provide safe working areas. The ideal platform at the near anchor allows construction of the high line without the use of artificial height.

c. Clearance. Allow for space between the load and the rope for easy hauling of troops and or equipment.

d. Bi-pod Location. Where to locate the bipod (if needed), sufficient area to build, load and operate the system.

Identify the Equipment Needed to Construct a High Line Traverse.

Equipment Required for Construction. (Numbers and lengths may vary due to type and method of installation.)

a. Static installation ropes.
b. Locking carabiners.
c. 1 inch tubular webbing.
d. 7mm utility cords
e. Non-locking carabiners.
f. If it is necessary to gain additional height to clear obstacles construct a bipod. You may locate the bipod at either the loading or the unloading platform. This will require additional equipment.

Table of Contents

Anchor the Installation Ropes.

a. Secure the Installation Ropes.

(1) Secure the installation rope to the far anchor with a bowline or high strength tie off.

Note: The height of the anchor depends on the loading/unloading platforms.

Construct the Tightening System/Near side anchor.

a. **Tightening Systems.**

(1)*Transport Tightening System*: For speed and simplicity the transport tightening system is the preferred method when trees are available and the working platform is large:

(a) Route the running end of the installation rope around or through the anchor.

(b)Place a figure eight slip in the installation rope as far away from the near anchor as possible, creating a 12-inch bight. Place a half hitch around the midpoint of the bight securing it in the direction of pull. Place a locking carabiner in the bight.

(c) Route the rope through the carabiner, working from the inside to the outside. Route the running end back to the anchor. Have no more than three Soldiers tighten the system.

(d) Take the running end of the tightened static rope around the near anchor creating a minimum of one round turn (360 degrees contact with the tree).

(e) After the round turn, take up a large bight of rope.

(f) Pass this bight under the single strand and tie two half hitches (that form a clove hitch) around the double strand.

(2)When the loading platform is too small to tighten the installation rope with one pull, use a 3:1 simple hauling system ("Z-Pulley") to tightening it (See Hauling Systems lesson, 071-9015 for description) . This method takes more time to construct and uses more equipment but allows for resetting the tightening system multiple times when more than one pull is necessary to get the high line tight.

Construct and Attach the Carrying sling.

a. **Carrying Sling**: A Carrying sling is one method used when transporting personnel on a High Line; it can be modified as necessary for transporting equipment.

(1) *Construct a Carrying Sling.*

(a) Join the two ends of a piece of webbing with a water knot.

(b) Place a locking carabiner on the high line and place the webbing into it. Ensure the joining knot is offset and not touching the locking carabiner.

(c) Place another locking carabiner in the webbing to attach the load. Use a pulley if available.

(d) The webbing can be shortened by clipping both ends into the locking carabiner on the high line. The other locking carabiner can now be placed into the two bights. (double up the webbing).

(2) Attach the Belay Rope.
(a) Attach a belay rope to the locking carabiner on the high line. Use a fixed loop (double figure of eight) and a locking carabiner.

Note: Attach a tag line to the carry sling (from the far side anchor), if the high line is near horizontal to pull the load across.

Note: Use two separate installation ropes (for training) and a locking carabiner when moving Soldiers.

Construct and Operate the Belay.
a. **Construct the Belay / Lower.**
(1)*Belay Rope*. Insure the belay rope is routed from the top of the backstack pile.
(2) Anchor.
(a) Build a suitable anchor.
(b) The anchor for the tightening system can be used or create another separate anchor just for the belay.
(3) Belay Method.
(a) The belay/haul line may pass around a tree or through a locking carabiner or pulley to keep it in line with the main installation ropes.
(b) Lower the load using an appropriate friction method. The munter hitch provides sufficient friction for most High Line lowering applications. If loads heavier than one man with equipment must be lowered down a steep highline then increase friction by using a super munter. If the munter hitch provides too much friction then use a round turn, terrain belay or redirect as appropriate.

b. **Operate the Belay / Lower**. Whenever a load is lowered down or across a high line, use a belay to control the load. Slowly belay the load. Use the following type of belay system.
(1) *Soldiers*. Two Soldiers are needed to operate the belay. One is used for rope organization and the other operates the belay when needed.
(2) *Position the Belayer*. Position the belayer so he can see the load as it moves down. If the terrain blocks the view of the belayer, set up a relay.

Perform Load Attachment.
a. **Attachment of Soldiers**.
(1) Attach the carry sling to the Soldier by clipping the locking carabiner to the Soldiers harness.

Safety: Make sure that the Soldier holds onto the carry sling and not the tightened ropes.

b. **Attachment of Equipment**.
(1) Attach the carry sling to the load by clipping the load into the locking carabiner.
(2) Make sure that the load is balanced and tied together correctly.

Operate a High Line: Lowering.
a. **First Load**. The first load should be a non-critical load. Belay this load to within 2 meters of the bottom anchor.
b. **Mark the Position**. Mark the position on the belay rope by tying a double figure eight. This will limit the travel of the belay rope. Attach the double figure eight to an anchor so loads cannot hit the bottom anchor.
Table of Contents

Operate a High Line: Raising.

a**. Hauling System**. Replace the belay system on the belay rope with a Simple 3:1 Hauling System with anchor prusik. Be aware that you reduce your sensitivity to the load when the 3:1 mechanical advantage is in the system. Keep the hauling line and the load rope as close to parallel as possible.

Note: All techniques described in this chapter may be altered for various situations and applications. The information here will give you a basis to work from.

Retrieve the High Line

In order to recover the equipment used to build the high line one or more Soldier s must remain on the near side and either find some other means to cross the obstacle or rig the high line to be retrieved. Recovery personnel should send all non-essential equipment that may hinder them across with the main body either way. Security for recovery personnel must be maintained.

a. **Recovery personnel cross some other way**:

(1) This method is time consuming.

(2) Soldier(s) must be capable of negotiating the obstacle alone. If the obstacle is a stream, then Soldier(s) must be a strong swimmer. In this case a loose tag line may be used to support the Soldier while swimming.

(3) If the obstacle is a ravine, the Soldier(s) must be capable of climbing or rappelling down the near side and climbing back up the far side. Main body may be able to assist in climbing the far side using belay systems or hand lines.

b. **Rigging High Line for recovery:**

(1) Near side personnel untie the high line system maintaining the near side ends of both the installation rope and belay/tag line rope.

(2) Far side personnel pull all slack across the obstacle.

(3) Near side personnel secure the end of the installation line to the anchor:

(a) Tie a double figure 8 in the end of the installation rope

(b) Secure the double figure 8 to the installation rope around the anchor with a locked carabiner.

(4) Far side personnel pull the installation rope tight with several personnel and then wrap it around an anchor tree a minimum of two full wraps. Those personnel maintain control of the end of the rope keeping it tight with the tree. Another method is for far side personnel to build a new tightening system on their side to tighten the rope.

(5) Near side personnel attach the tag line to installation line double figure 8 using a locked carabiner and a double figure 8. The tag line remains slack.

(6) Near side personnel attach themselves to the installation line in the same way the main body and cross the high line.

(7) Once all personnel are on the far side, the installation rope is unwrapped from the far side anchor and allowed to go slack. If a new tightening system was used it is broken down.

(8) The tag line is then pulled across the obstacle dragging the installation line with it until both ropes are on the far side. Ensure all knots are removed from both ropes before pulling.

Table of Contents

NEAR SIDE

FAR SIDE

Table of Contents

Notes:

24 - Communication in a Mountainous Environment

071E9014

INTRODUCTION: The enemy often benefits from the mountain environment's degradation of many of our technological advantages particularly communications. Far too often we fail to take into account the affects of weather and terrain on our communications equipment. Soldiers who understand these affects and the techniques to mitigate them such as field expedient antennas will greatly increase a leader's ability to command and control his unit.

Limitations of communications in the mountains.

a. Communicating in the mountains is a challenge since there are few ideal spots for communication. FM radios, which are line of sight systems, frequently cannot communicate because their signals are absorbed by terrain folds and features. If all the force is on the same side of the mountain and the mountain forms a bowl, FM communications are usually possible. However, radios located on the same side of the mountain at different altitudes have difficulty communicating because of intervening terrain and communications dead space. If the force is deployed on the same side of a mountain, which curves out, communications, are especially difficult. Even FM radios located on the summit of the mountain have difficulty communicating with radios located further down the mountain slope due to dead space.

b. Communication sites must be carefully selected–and often become key terrain. When line-of-sight communications in mountains are possible, communications are excellent, but there are few sites where line-of sight is possible to all other elements in the net.

c. There are often only three solutions–move the radio either to where it can communicate, set up a radio retransmission site or relay messages across the net.

Types of Communication in the Mountains.

a. Single Channel Ground and Airborne Radio System (SINCGARS)

(1) The Single-channel Ground and Airborne Radio System (SINCGARS) family of frequency modulation (FM) radios is good for the control of battalion and smaller-sized units operating in a mountainous environment (see FM 6-02.32 and FM 6-02.18). If available, hands-free radios, such as helmet-mounted radios, are an excellent means of communication for small unit tactics and close-in distances, particularly while negotiating rugged terrain. In colder environments, shortened battery life greatly reduces the reliability of man packed systems that rely on constant voltage input to maintain maximum accuracy.

(2) Since even a small unit may be spread over a large area, retransmission sites may be needed to maintain communications and increase range. These sites require extensive preparation and support to ensure the survival of personnel and the continued maintenance of equipment. Retransmission systems are often placed on the highest accessible terrain to afford them the best line-of-sight; however, through simple analysis, these locations are often predictable and make them more vulnerable to enemy interdiction. The importance and difficulty of maintaining adequate communications in mountainous terrain requires commanders to devote additional resources for the protection of these limited assets and operators skilled in the proper use of cover and concealment, noise and light discipline, and other operations security (OPSEC) measures.

(3) Physical range limitations, difficulties in establishing line-of-sight paths due to intervening terrain, and limited retransmission capabilities often make it difficult to establish a brigade and larger-sized radio net. However, commanders can, if within range, enter subordinate nets and establish a temporary net for various contingencies. In the mountains or if the mobile subscriber equipment network is not yet fully developed, commanders should consider the increased need for the improved high frequency radio (IHFR) family of amplitude modulation (AM) radios and single-channel tactical satellite communications terminals for extended distances.

b. Satellite Telephones/ SATCOM: Satellite telephones are excellent for emergency communications in the mountains. Advantages include lightweight, mobile enroute communication; can penetrate foliage, and virtually unlimited range. These systems have there limitations also, batteries are very limited, they are difficult to encrypt, and are not always available in every unit especially at smaller unit levels.

c. Audio, visual and physical signals: Audio, visual and physical signals can be quick and effective if SOPs are established prior to the operation. Leaders can use simple audio signals, such as voice or whistles, to locally alert and warn. Sound travels farther in mountain air. Although this effect may increase the possibility of enemy detection, interrupting terrain, wind conditions, and echoes can restrict voice and whistle commands to certain directions and uses. Like audio signals, visual signals such as pyrotechnics and mirrors have limited use due to enemy detection, but may work for routine and emergency traffic at the right time and place. Blowing sand or snow, haze, fog, and other atmospheric conditions may periodically affect range and reliability. Units should use hand and arm signals instead of the radio or voice whenever possible, especially when close to the enemy. A tug system is a physical method of signaling between members of a roped climbing team. However, tug systems are often unreliable. Separate tug lines can be installed in static positions by tying a string, cord, or wire from one position to the next. Soldiers can pass signals quietly and quickly between positions by pulling on the tug line in a prearranged code.

d. Aircraft: Using Command and Control (C2) aircraft can assist in overcoming ground mobility restrictions and may improve communications of units on the ground. In the mountains, terrain masking, while making flight routing more difficult, may provide the degree of protection needed to allow an increased use of aircraft. To avoid radar or visual acquisition and to survive, C2 aircraft must use the same terrain flight techniques employed by other tactical aviation units. This flight method often degrades FM communications and reinforces the requirement for radio relay or retransmission sites.

e. Landline communications: Landline communications in the mountains can also pose serious problems. The time needed emplace and remove field cable lines can be doubled and the amount of line needed can be doubled. Wire lines are laid along roads, river valleys, and other accessible areas of terrain. It is much harder for personnel manning line elements and those that service, guard and protect field cable communication lines to find their bearings in the mountains.

f. Line of site radio communication: Line of site radio communication is generally the preferred method of communication but is not always an option in the mountains. Because of the effects of irregular terrain patterns, cold, ice, and dampness on communications equipment line of sight communication is not reliable at any great distance without precise planning and extensive coordination.

g. Messengers: The use of messengers is a possible means of communication but is usually a last resort if nothing else will work. Messengers should be trained climbers, resourceful, familiar with mountain peculiarities, and able to carry their own existence load. During the winter, advanced skiing skills may also be required. Messengers should always be dispatched in pairs. Vehicles may also be employed to maintain messenger communications when conditions of time, terrain, and distance permit.

h. Relay transmission: Relay transmission can be moderately effective as a means of communication. This is very time consuming and often the message is not relayed accurately.

Table of Contents

i. <u>Retransmission:</u> Retransmission sites can greatly assist in maintaining and increasing range of communications in the mountains. These sites require extensive preparation and since the retransmission team must work away from the main body, it must have enough personnel to protect itself and haul all its gear to the retransmission location. Batteries, antennas, guy wires, rations, water, weapons, ammunition and personnel gear are heavy. These retransmission teams need to constantly relocate to keep up with the main body despite the fact that the main body will generally be moving over easier terrain. Retransmission systems are often placed on the highest accessible terrain to afford them the best line of sight; however, through simple analysis, these locations are often predictable and make them more vulnerable to enemy interdiction.

Field Expedient Antenna Definitions.

a. Knowledge of field expedient antennas will enable the Soldier to establish lines of communication in mountainous areas with limited vehicle access and where traditional communication equipment cannot feasibly be carried. The types of field expedient antennas will vary with terrain and mission requirements.

(1) *<u>Omni-directional</u>*. Radiating energy equally well in all directions, the omni-directional antenna is used when it is necessary to communicate in several separate directions at once. It will also receive in all directions.

(2) *<u>Bi-directional</u>*. Antennas produce a stronger signal in two favored directions while reducing the signal in other directions. Tactical bi-directional antennas are usually sloping wires and dipoles. It creates nulls in the areas not receiving energy. These antennas have to be positioned correctly (by azimuth) in order for them to work.

(3) *<u>Directional</u>*. Similar to the bi-directional antenna except it has one of its transmission lobes cut off. Many bi-directional antennas are made directional by the addition of a resistor that sucks up the second lobe.

(4) *<u>Antenna Gain</u>*. Gain is the term used to describe how well an antenna radiates power. It is necessary to know what the gain of an antenna is being compared to before two antennas can be compared. In some cases, an antenna is said to have gain compared to an isotropic antenna and the gain is expressed in dBi.

(5) *<u>Patterns</u>*. Antenna patterns graphically show the radiation for a specific antenna.

(6) *<u>Insulators</u>*. Insulators prevent the energy being transmitted from the RT of the radio from escaping out of the end of the wire that you are using as an antenna. If the radio's energy goes out of the end of the wire, your transmission goes nowhere. Tie the end of the wire of the expedient antenna to an insulator and your transmission energy is safe.

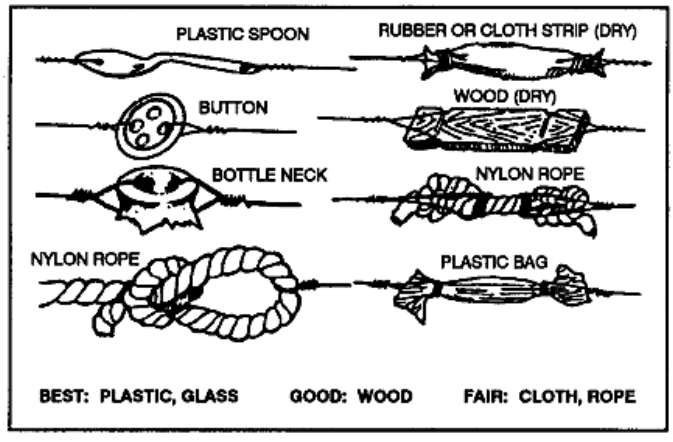


Figure 7-2. Improvised insulators.

(7) *Resistors*. Resistors make antennas directional and are ideal for expedient antennas. They draw energy from the RT towards it and then shoot it off in the transmission. Ideally you want a resistor with the wattage of ½ of the max of the radio you are using it on and 600-800 ohm. You can add resistors together to add them together or subtract from each other. Each color band on fabricated resistors represents a certain ohm factor.

(3) *Grounding*. Grounding performs two functions. First, it provides a path for electrical discharge into the earth to prevent shock to the operator or damage to the equipment. Secondly, it enhances radio signal strength and helps eliminate static. The major consideration for a good ground is the ground stake. A good metal-to-metal connection must be made to complete the path for the ground. Select the ground rod and drive it into the earth. Ensure that there is a bare metal surface to connect the ground strap. Connect the other end of the strap to the ground terminal on the radio to complete the ground path.

Considerations for Maintaining Antennas in the Mountains.

a. Antenna icing, a common occurrence at high elevations, significantly degrades communications. Ice may also make it difficult to extend or lower antennas, and the weight of ice buildup, combined with increased brittleness, may cause them to break. Antennas should have extra guy wires, supports,
and anchor stakes to strengthen them to withstand heavy ice and wind loading. All large horizontal antennas should be equipped with a system of counterweights arranged to slacken before wire or poles break from the excess pressures of ice or wind. Soldiers may be able to remove wet snow and sleet
that freezes to antennas by jarring their supports, or by attaching a hose to the exhaust pipe of a vehicle and directing the hot air on the ice until it melts. However, Soldiers must exercise great care to ensure that the antenna is not damaged in their attempts to dislodge the ice.

b. Ground rods and guy wires are often difficult to drive into rocky and frozen earth. Mountain pitons are excellent anchors for antenna guys in this type of soil. In extreme cold, ropes can be frozen to the ground and guys tied to these anchor ropes. Adequate grounding is also difficult to obtain on frozen
or rocky surfaces due to high electrical resistance. Where it is possible to install a grounding rod, it should be driven into the earth as deep as possible or through the ice on frozen lakes or rivers. Grounding in rocky soil may be improved by adding salt solutions to improve electrical flow.

Table of Contents

Notes:

25 - Vertical Danger Areas
071E9020

INTRODUCTION: The ability to successfully negotiate vertical danger areas in a mountainous environment greatly enhances unit mobility and forces the enemy to defend multiple avenues of approach. Standard Operating Procedures for linear danger areas should be applied to Vertical areas with some additional considerations.

Identify the Types of Vertical Areas.
Assessment. As with any danger area, they can be identified during the mission planning process (Deliberate) or identified during the conduct of the mission (Hasty). When time is available, a leader should conduct a detailed METT-TC for patrol routes and determine the risk of difficult terrain. Conducting a map reconnaissance does not always allow leaders to identify difficult terrain due to map quality and size. Whenever possible, utilize satellite imagery, aerial photographs, local guides and 3D holographic maps to present a better picture of the terrain. Additionally, weather, seasonal conditions and visibility can greatly affect a unit's ability to conduct a movement over difficult terrain. In most cases the terrain can be broken up into three categories: Easy, Moderate, and Hard.
a. **Easy.** Easy Terrain is considered up to and including third class terrain. Movement in this terrain can be as simple as changing a movement formation to requiring a simple fixed rope to move up or down (knotted hand line or hasty rappel). Easy Terrain requires minimal additional equipment and training to overcome. Movement times are minimally effected but should be accounted for. Any Soldier sustaining a fall on Easy Terrain would not result in death but could result in injury requiring medical evacuation.

b. **Moderate.** Moderate terrain is classified as exposed third to fourth class terrain. Movement in this terrain requires the use of a simple fixed rope or complex fixed ropes. Moderate terrain will require Level I or even Level II Mountaineering skills for the construction of suitable anchors and fixed rope routes. The number of trained mountaineers will depend on the size of the element being moved, amount of mission preparation, and the number/complexity of systems being installed. It is important for leaders to accurately assess their units' ability and training as falls sustained under moderate terrain can result in death.

c. **Hard.** Hard terrain is exposed fourth or fifth class terrain. Movement in hard terrain will require the use of complex fixed ropes and the potential usage of other systems (hauling, high lines, rappelling etc). In order to safely negotiate hard terrain, trained Level I and Level II Soldiers are required. Leaders should use the knowledge and experience of the patrol members before making movement decisions. In many cases this terrain can be bypassed. The time it may take for installation, movement, and recovery is often underestimated and could adversely affect the mission. With proper training, equipment, and risk assessment this terrain can be your best option for movement. It is often lightly defended, but will also leave your element heavily exposed while under attack.

Identify Recon and Security Emplacement.
a. **Recon/Security Emplacement.** Depending on patrol size and situation, both recon and security emplacement can be accomplished together. Depending on the area and mission, a simple security halt can be conducted to push Soldiers out to recon and secure the high ground. Employment of a recon/security element should approach the same as any other danger area. It is critical that leaders use this time to task organize personnel and equipment.
Table of Contents

b. **Recon.** Regardless of the type, a suitable recon should be conducted to ensure the area is safe to continue movement or to allow for the installation of systems. This should be completed in similar fashion to a stream crossing or danger area, with subtle differences. Similar to a stream crossing, the recon element will move to the vicinity of the vertical danger area, ensuring the element is not exposed to enemy small arms fire from above. METT-TC will determine how close the recon element to gain observation but maintaining the ability to break contact

c. **Security Emplacement.** For easy terrain, the seamless transition from traveling over watch to bounding over watch may be in order. However, in when rope installations are necessary, Left/Right side security and Cliff Head Security will be necessary. Emplacement of security at the loading and unloading point is useful for controlling movement on the installation lines and to control massing of personnel at key locations. It may be advantageous to not expose more than a Fire Team at one time in either location.

(1) *Left and Right Side or Near Security.* Just like the security for linear danger areas, the left and right security should have an automatic weapon and an M203. METT-TC will dictate security placement, understanding not to be too close to the cliff head as this may expose Soldiers to enemy fire from above and below the vertical danger area. Alternate firing positions may need to be established to engage targets on the cliff head. When developing a Soldier load plan it may be advantageous to have these Soldiers carry ropes and drop them prior to taking security positions. In most cases, they will be the last personnel to move across the VDA and will be available to assist the installation team in rope recovery.

(2) *Cliff Head Security*. Cliff head security is an additional element compared to linear danger areas. Cliff Head security should be placed close enough to actively scan and engage the Cliff Head but provide enough standoff to break contact after providing cover fire. The use of Snipers/Squad Designated Marksman greatly enhances the effectiveness of cliff head security. Emplacement of over-watch personnel can be done prior to moving over the deliberate VDA.

(3) *Covering Dead Space.* If available, Forward Observers should be pre-planning targets on the area directly behind the Cliff Head and exposed cliff face areas. Pre-planned fires are a critical element for breaking contact.

(4) *Topside or Far Side Security.* Once the topside has been cleared, leaders may choose to use topside security. These positions should be close to the VDA to allow contact with the nearside security elements and to utilize the elevated position to their advantage.

Identify the Role of the Installation Teams.

a. *Installation Team Responsibilities.* Depending on the type of system the installation team may vary from a level I-III. Regardless of their level the team that installs the system should maintain and monitor it during its use. This is important to the flow of personnel and the possible degradation of the instillation. This will depend primarily on three factors Proficiency, Equipment, Complexity.

(1) *Proficiency of the Team.* Trained military mountaineers are critical to effectively overcoming vertical danger areas. As with any specialty team assignment (Aid and Litter, Demolitions etc), sustainment training and rehearsals should be conducted whenever possible. Installation team proficiency can affect mission timeline and safety. Leaders need to fully understand their Soldiers' capabilities prior to conducting operations in a mountainous environment.

(2) *Equipment Available.* To reduce the burden of additional equipment, installation teams should train to conduct VDA with minimal equipment. Equipment with multiple uses should be utilized while single purpose equipment should be avoided when possible. Mountaineers should stay current on available equipment as items are becoming lighter and stronger.

Table of Contents

(3) *Complexity of the System.* The system being installed should remain as simple as possible. The complexity of the system will be determined on METT-TC and installation team capabilities. Installation teams should not try to install systems beyond their capabilities and should remain as simple as possible. Overly complex systems are time consuming for setup and troop movement. The end state is to establish an appropriate system that is safe and leads to mission accomplishment.

b*. Actions during Installation.* It is the responsibility of the installation team to safely negotiate the obstacle and may be responsible for clearing the far side. TTP's will change depending on the complexity of the system and the amount of additional equipment that has to be carried. On Easy or Moderate terrain, installation teams will most likely be armed with M-4's and clear the far side. On difficult terrain, installation teams may be required to switch out weapons and climb with just M-9. When clearing the far side ensure provisions are in place for actions on contact. Rappel lines (if applicable) are in place and Soldiers are prepped to move on them if breaking contact. The task organization of key weapons and leadership is critical to insure survivability in case enemy contact is made

Preparation of Personnel and Equipment to Cross a Vertical Danger.

a. **Duties in the Security Halt/ORP.** As the installation team begins to install the system, leaders at the security halt/ORP will begin to prep equipment (if necessary) for individual movement. A member of the installation team should be present during rigging of individuals to inspect Soldiers and advise on equipment requirements. For more information go to 'Fixed Ropes, 170-9019' 'ELO C' for details on movement on a fixed rope.

b. **Slinging/Packing Weapons** Movement on fixed ropes may require the use of both hand depending on the terrain difficulty and complexity of the system. Leaders will need to determine if their Soldiers should sling their weapons or pack them in their rucksacks for the movement. Leaders need to weigh the chances of enemy contact with speed/safety of movement on the system. If the weapon is to be slung, ensure that Soldiers do so at their side. Weapons that are slung in the front will generally scrape the ground/cliff and hit the Soldier's knees. It is unrealistic to think that Soldiers will be able to return effective fire while moving on a system. A Soldier who takes fire while moving on the system is to take immediate cover and/or hastily move up or down the system. Soldiers in over watch positions should increase fires until the system is clear to facilitate this action.

c. **Discrepancies of Follow-on Troops.** Soldiers' must be inspected for proper equipment and rigging prior to moving to the base of the system to ensure exposure is limited and movement is uninterrupted. The installation team should radio back any additional hazards to the security halt/ORP leadership to disseminate information to Soldiers.

Identify Movement Techniques of Follow-On Troops at a Vertical Danger Area.

a. **Prior to movement.** The element should be briefed on any major requirements to negotiate the route. In most cases this will be done at the ORP. If changes have been made to the route, Leaders and Soldiers will need to be briefed. Accountability of personnel will be on the element being moved. In most cases this will be done at the loading site on the near side.

b. **Task Organization.** Unlike most linear dangers areas, breaking contact is considerably more difficult. Leaders must plan to task organize leadership and key weapons to ensure continuity on both sides of the VDA. Fire Team/Squad integrity should be maintained whenever possible to assist in accountability. If multiple routes are established, it may be feasible to move a team up multiple routes so all members arrive at the top around the same time, allowing better command and control. Leaders must understand how they will react if contact is made at the beginning, middle or end of the system routes.

c. Table of Contents

d. **Establish a Release Point.** Soldiers will often bunch up at the nearside loading platform while waiting to hook up to this system. Leaders need to prevent this from occurring, calling individuals forward, one at a time, to minimize exposure.

e. **Responsibilities of the Lead team During Movement.** Key areas should be manned by the installation team during movement. These positions will depend greatly on the size of the element, type of terrain and hazards to name a few. Positions may include:

(1) *The nearside loading platform.* This is generally the most important position and should be manned by the units most experienced military mountaineer. This Soldier will control the loading and movement on the system, briefing of any additional route information and provide a final inspection point.

(2) *The far side-unloading platform.* The second key position to be manned is the far side unloading platform. This position can be occupied by a member of the installation team or key leader. This Soldier will provide guidance on stowing equipment/recovering packed gear and weapons, provide tactical guidance and orientation to continue the mission. Similar to the near side loading platform, Soldiers will have a tendency to congregate at this point. Soldiers should follow direction and immediately move away from the unloading platform to minimize exposure.

(3) *Along the installation.* Installations can range greatly in complexity. In some cases, installations may be very long in length, and require guidance or assistance through multiple sections. An installation team member might use an existing anchor point or establish separate positions to work from. This Soldier should be placed at key locations to assist Soldiers, help in communications, provide advice on hazard areas and overall system flow. It is important this Soldier does not impede the movement of the follow-ons or overload a single anchor point.

Conduct Installation Recovery Procedures.

a. **Recovering the System.** The final step is the recovery of the system and continuation of movement. In most cases, the team that installed the system will conduct recovery. Ropes should be kept neat and all equipment should be accounted for. Some installation team members may opt to back stack ropes inside of rucksacks (as opposed to coiling ropes) if other rope installations are expected on the mission (allowing ease of deployment of the rope).

b. **Responsibilities of the Installation Team.**

(1) Recover System
(2) Account for Equipment
(3) Return as a member of the Patrol.

c. **Responsibilities of the Element.**

(1) Aid in recovery of equipment (if needed)
(2) Recover and stow personal gear used during movement.
(3) Continue the patrol.

d. Installation Stays in Place*.* The majority of operations will require that the system be recovered, as it may be needed later. However, there are certain times when the equipment will stay in place. If the threat level is high enough that the risk of recovery outweighs the benefit of the equipment, it may be left behind. If equipment is left behind, it should be rendered inoperable. Under certain circumstances, if the objective is close enough, the systems may be left in place to better facilitate ex-filtration. If the system is left and planned to be used again, security should be left in place to secure the route to minimize a potential ambush point.

Table of Contents

Example: Crossing a Vertical Danger Area Annex.

1. SITUATION:
   a. Enemy Forces (Mountain Proficiency, Cold Weather Skills)
   b. Friendly Forces
   c. Environmental
      (1) Terrain
         (a) Ground Composition- (Rock, Talus, Scree, Snow-Ice)
         (b) Terrain Assessment- (Easy, Moderate, Hard)
         (c) Snow Depth and Avalanche Hazards- (Overlay)
         (d) Ground Slope and Vertical Obstacles
         (e) Friendly Forces-Assault Climbers Technical Skills, SQI-E, Mountain Training, Soldier Load & Mountain
      (2) Weather.
      (3) Equipment (Mountain Equipment / HAM Kit)
   d. Attachments and Detachments-(Assault Climber Teams, Sniper Team (over-watch), etc...)

2. MISSION: (Include Deliberate and Hasty VDA movement)

3. EXECUTION:
   a. Concept of Operation
      (1) Maneuver
         (a) Easy Terrain (Class I and II). Slow movement terrain. Consider ease of movement, night movements, weather, walking surface and Soldier load. Recommended systems and movement techniques:
            1- Simple Fixed Rope Installed (when needed)
            2- Hand Line (knotted) for ease of movement (for assistance)
            3- No system if terrain allows
            4- Descending techniques (hasty or body rappel)
            5- Harness not required
         (b) Moderate Terrain (Class III and IV). Slow moving technical terrain. Consider Soldier movement techniques and technical equipment. Recommended systems and movement techniques.
            1- Simple or complex fixed ropes
            2- Ascending methods:
            3- Double-headed safety line (safe and fast when viable)
            4- Mechanical ascenders (safe not fast)
            5- Hand over hand method (fast not safest)
            6- Prusik safety (simple fixed rope only)
            7- Descending techniques (hasty/body rappel, belayed rappel, rappel devices: figure 8, ATC) terrain dependent.
            8- Harness required (field expedient or manufactured)
         (c) Hard Terrain (Class V). Extremely slow movement. This terrain will require technically proficient installation teams and technical gear. Preparation to move over this vertical surface will take time. Recommended systems and movement techniques.
            1- Complex fixed ropes
            2- Installation team preparation (lead climber team)
            3- Ascending techniques
            4- Two -mechanical ascender method (safe but gear intensive)
            5- Prusik ascent method (slow but not gear intensive)
            6- Mechanical ascender with prusik back-up (safe not fast)
            7- Mechanical ascender with single point attachment back-up (safe and easiest)
            8- Hauling system for personal equipment and team gear (high-line)
            9- Descending techniques (belayed rappel, rappel device)
            10- Harness required (field expedient or manufactured)
      (2) Fires- (FDC needs elevation of targets)

Table of Contents

(3) CASEVAC PLAN

b. Tasks to Maneuver Units
   (1) Elements
   (2) Teams- (Installation, Recovery, Loading, Unloading)
   (3) Individual- (Lead Climbers, Installers, Anchoring)

c. Tasks to Combat Support Units

d. Coordinating Instructions
   (1) Task-Organize Installation Team
   (2) Security Emplacement-(Left-Right, Cliff-head, Sniper Tm Over-watch)
   (3) Type of Installation System- (Special Equipment, # of Lanes)
   (4) Method and Order of Movement- (Simple/Complex Fixed Rope, Haul System)
   (5) Alternate Plan- (Fixed Rope Hazards, Alternate Movement Techniques)
   (6) Actions on Enemy Contact- (During Movement over VDA)
      (a) Far Side
      (b) Near Side
      (c) Elements Moving on VDA
   (7) Marking Release Point and Cliff-head (Top and Bottom)
   (8) Near and Far Side Rally Points
   (9) Link-up Plan- (Follow on Units)
   (10) Consolidation Plan- (Near side and Far side)
   (11) Recovery Plan
   (12) Rehearsal Plan
   (13) Time Schedule

4. SERVICE AND SUPPORT:
   a. Classes of Supply
   b. Transportation

5. COMMAND AND SIGNAL:
   a. Command (Task Organize)
      (1) Location of Patrol Leader- (Far Side)
      (2) Location of Assistant Patrol Leader (Near Side)
      (3) Location of CP

   b. Signal-(FM, Tug-Lines, Runners, Commands for moving on ropes)

6. SAFETY

Table of Contents

Notes:

26 - Mountain Patrol Base and Bivouac Operations
071E9089

INTRODUCTION: Before you can successfully fight in the mountains you must learn to live in them. Units that can sustain themselves in austere mountain patrol bases in all types of weather and temperatures can gain a significant advantage over an enemy who cannot. Soldiers who are well versed in field discipline, establishing shelters, and simple bivouac routines can focus on fighting the enemy and not the environment.

Identify site selection factors.

a. **Area of Operations.** Your mission dictates your area of operation. Enemy activity determines the likelihood of contact. Take both security and defensive posture into consideration. The AO site may be used for future operations. High ground is often preferred for defense but at times is disregarded in favor of cover and concealment or more suitable ground conditions.

b. **Cover and Concealment.** Cover and concealment from air and ground observation is essential for the bivouac area. Forested areas pose few problems in comparison to areas above the tree line. Operations above tree line or at altitude may offer less cover and concealment. Bivouac may need to be established below tree line to support operations conducted above tree line.

c. **Wind Protection.** Protection from the wind is a prime consideration. Depending on your area of operations bivouac site selections may vary due to the unpredictability of winds at elevation.

d. **Ground Condition**. The condition of the ground is important. In warm conditions bivouac should be located on hard ground. In snow-covered terrain avoid digging to the ground, as this may collect water due to the thawing of the snow, or rain. A layer of snow should be left for ground insulation, comfort, and absorption of water. The depth that is dug in will vary depending on the site selection and snow depth.

e. **Construction Materials.** Construction materials play an important part in the selection of a bivouac. When making a reconnaissance of the area, consider such things as the availability of firewood, water procurement, and snow for snow shelters.

Identify Bivouac Locations.

a. **Forests.** Most forests in cold regions provide excellent bivouac sites. Forests provide many natural materials such as boughs for insulation, firewood, and camouflage construction materials. They often provide excellent concealment against enemy air and ground observation. Coniferous (cone-bearing) trees provide better protection from wind and better insulation material than deciduous forests.

b. **Marshy Ground.** You may find good sites when the ground is frozen that would otherwise be unsuitable. Although surrounding areas may be frozen, swampy areas may not freeze due to warm water springs or gases. These usually provide poor facilities for the bivouac sites.

c. **Open Terrain and on Frozen Bodies Of Water.** Carefully choose sites on open ground. Some of the problems of an open ground site are strong winds, drifting snow and poor concealment. When possible, pitch tents where they are sheltered by natural windbreaks. Windbreaks may consist of depressions in the ground or ridges on the ice. A visual inspection

will indicate the degree of drifting, direction of the wind and suitable protected areas. Construct snow walls in areas where natural windbreaks do not exist. Snow walls provide protection from winds and small arms fire. In areas with high winds, snow gathers rapidly on the lee side. It is necessary to clear the sides and tops of the tents periodically to prevent the weight of the drifting snow from collapsing the tent. The entrance to the shelter should face downwind at a 45 degree angle. This prevents the snow from blocking the exit and cutting off the ventilation.

When on frozen lakes be aware that water may rise above the ice as it expands and pressure cracks are formed. In some cases this may not be avoided as pressure cracks/ridges may provide the only cover and concealment available. When on rivers be aware that heavy currents may cause drastic changes in ice thickness in relatively close areas.
Although the center may be stable, pay close attention to the outside edges where the current is usually heavier. Water levels may rise/drop throughout the year this may cause the ice to be unstable along the edges, and in shallow areas.

d. **Mountainous Terrain.** Mountainous regions often have strong turbulent winds, cold temperatures and general lack of concealment above the timberline. The wind overhead creates an extensive lee near the mountain. The overhead lee resembles the dry space behind waterfalls caused by water having such speed that it shoots over the edge of the cliff and descends in a curve. An inland wind blowing 50 miles an hour may not strike the ground for several kilometers after passing the edge of a cliff or a very steep slope. Such a lee is an attractive bivouac site from the standpoint of wind protection. Note that such a lee area is often an area of maximum snow deposit. The requirement to constantly dig out vehicles, walkways, and weapons positions may offset the wind free advantages of a lee site during snowfall or snow blowing weather. Avalanche hazard areas must be avoided. Cold air is heavier than warm air and frequently settles in valleys. If tactically feasible it is better to establish a bivouac up the hillside above the valley floor and below the timberline.

e. **Patrol Base Considerations.** In preparation of Patrol Base (PB) locations leaders must consider the terrain and environmental conditions closely. Leaders must have a well rehearsed occupation plan and be able to modify perimeter security contingencies to suit the terrain. Establishment of key weapon systems on avenues of approach is essential in mountainous environment as they will be limited in number. Setting in Observation Posts (OP's) should be done in such a manner as to have the best observation of key terrain without giving away your position. Consider occupying the PB below the crest of ridgelines and hills and maintaining OP's at the military crest with concealed routes to and from these OP's. Small unit leaders should consider, but are not limited to, these key areas when conducting PB operations.

1. Command and Control
2. Communications
3. Security

Procedures for establishing a mountain patrol base bivouac operation.

a. **Establishing a Bivouac.**

(1) *General.* Setting up a bivouac is based on a SOP which enables the commander to control the bivouac area, keep it protected and camouflaged, and maintain personnel ready to fight. Devote minimal time to pitching and striking shelters. Bivouacking in a routine manner allows rest, more time for daily movement, establishing an effective security system, defense of the bivouac site and making preparations for the continuation of the operation.

(2) *Unit Leader Responsibilities*. When entering the bivouac site, the unit leader should:

(a) Post security.

Table of Contents

(b) Check the bivouac site.

(c) Determine exact locations providing the best natural shelter and camouflage.

(d) Designate an area from which construction material and firewood will be obtained.

(e) Select a water point, or marking off the snow area to be utilized for water.

(f) Designate latrine and garbage disposal sites.

(g) Designate a site for weapon and ski racks. Temporary placement for weapons and equipment must be arranged until the bivouac has been established.

(h) Break a minimum number of trails between the tent site and area assigned for firewood and construction material, water point, and latrine.

(i) Maintain camouflage and track discipline at all times.

(3) *Organization and Work Assignments*.

(a) Clear and level the shelter sites. In winter, dig the snow to ground level or pack it down with skis, snowshoes or tracked vehicles.

(b) Pitch tents.

(c) Cut, trim and haul trees and boughs for construction of improvised shelters and bough beds (when tents are not available).

(d) Construct an improvised shelter best suited to the area concerned.

(e) Construct a windbreak.

(f) Build weapon and ski racks. Give special care to the protection of weapons from the elements.

(g) Construction of field latrines and garbage disposal sites.

(h) Prepare a water point.

(i) Gather and cut firewood.

(j) Start fires and prepare hot drinks for all individuals.

(k) Upon completion of shelter construction, start a warm meal.

(l) Maintain and emphasize cleanliness, tidiness, and teamwork.

(m) Prepare defensive positions, break and mark a trail from the shelters to the positions.

(n) Maintain a duty roster for exterior guards, fireguards and similar assignments.

(o) Rotate individuals on all jobs on a daily basis.

(p) Assign specific sleeping areas for all individuals in accordance with the duty roster.

(q) Upon establishing the bivouac, removing the exterior guard when the parent unit has taken over the security of the area.

(r) Inspect the area; examine the security, camouflage, cover, weapons, skis, sleds, vehicles and the condition of the men and their equipment.

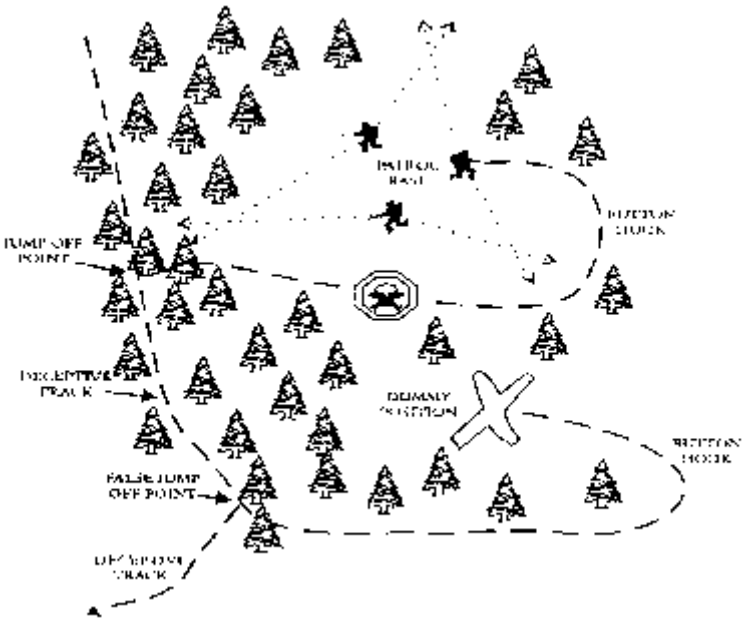
(s) Outline and rehearse battle drills in the event of attack.

(4) *Patrol Bases*: Deceptive actions are mandatory in a snow-covered mountainous environment. Make use of jump-off points, deceptive tracks, and hasty ambushes.

(a) Jump-off point: Is made on slopes or in dense woods where it is possible to hide the real track and where enemy pursuit will have such a high speed of travel that it is difficult for him to discover where the real track is, as well as any booby traps. The deceptive track should be made as far away as time permits.

(b) Button Hook: Is the preferred method of setting in a track plan to a patrol base. This technique allows the track to be observed and covered by fire during the occupation of the position.

(c) Deceptive tracks: Used to mislead the enemy from your jump-off position. They should be located in an area where you can observe them and cover them with small arms fire from the patrol base.



EXAMPLE PATROL BASE PLAN

(d) During occupation of the patrol base minimal activity should occur. Therefore, it may not be advisable to dig communication trenches and defensive positions. All food preparation, water procurement, weapon maintenance, etc. should occur in a covered area.

(e) Due to the possibility of patrol base becoming detected and engaged by a superior enemy force, a contingency plan for escape must be planned, practiced, and implemented. Impeccable bivouac routine and security are the best means of preventing this possibility from becoming a reality. Here are some of the guidelines to follow:

(1) All equipment when not in use will be in the pack, (i.e., sleeping bag, stove, fuel, extra clothing, etc.)

(2) Due to the importance of equipment to Soldiers in a cold weather environment, patrols operating out of a patrol base should take precautions prior to leaving, in case the patrol base becomes compromised and the patrol has to be self sufficient.

Bivouac site activity.

a. The reality of a mountain bivouac is that the majority of your time will be spent preparing your site. The key to keeping Soldiers focused once you have reached your destination is to keep them warm and keep everyone busy.

(1) *Arrival Sequence.*

(a) Designate a latrine area

(b) Designate each team site and begin stomping out a level area approx. 8 x 8 feet for a kitchen area, then let the snow settle for about 20-30 minutes.

(c) While that snow is settling begin setting up the tents. On windy nights you will want to construct walls. After all the tents are set up, dig out the vestibules.
(d) Once the tents are up and the vestibules are dug, have everyone start unpacking. Unpack only what you need and put your sleeping pads, bags and anything else they will need for the night in their tent.
(e) By this time your kitchen area should be settled so start digging, leave about a 3 x 3-foot "table" in the center; pack all of the snow you dig out around the perimeter of the pit and construct snow walls.
(f) Start cooking and melting snow for water.

(2) *Sleeping Sequence.*
(a) After dinner, fill your water bottles for the next day with hot fluids and place them in your bag to pre warm it (make sure Soldiers are using Lexan bottles and remind them to crank down on the lids to prevent spills).
(b) Pre-warm yourself (do some jumping jacks and empty your bladder).
(c) It is usually a good idea to get situated in the tent one at a time.
(d) Take your boots off in the vestibule, brush off excess snow from the shells. Remove the liners and place the liners inside of your sleeping bag. Place the shells under your sleeping bag on top of your sleeping pad.
(e) Place your Gore-Tex layer between your pad and bag, spread flat and even.
(f) Tell everyone to take any damp cloths, their boot liners, and anything they want warm in the morning into their bag with them and sleep with it against the trunk of their body.
(g) Encouraging everyone to sleep with a hat and to urinate when they have the urge rather than holding it.

(3) *Departure Sequence.*
(a) It is usually best to get organized one at a time.
(b) Wake up, dress, and pack all of your equipment inside the tent.
(c) The first out of the tent starts boiling water for breakfast.
(d) Shake out your sleeping bag and let it dry in the sun or place it into a stuff sack. If your are staying overnight, leave your sleeping bag in the tent.
(e) Once the water is boiled, shut down the stove as soon as possible to let it cool before you pack it to leave.
(f) Tear down the tent, shake out, and divide the components between the Soldiers.
(g) Knock down snow walls and fill in positions.

Establishing a bivouac on a glacier.

a. **Location.** When locating a bivouac site or a gathering area where the team might need to unrope, at least one person will need to "probe" the area for hidden crevasses. The best type of probe will be the manufactured collapsing probe pole, at least eight feet in length. Other items could be used but the length and strength of the probe is most important. Other rope team members will belay the probers. The prober is "feeling" for a solid platform to place the tent by pushing the probe as hard and deep as possible into the surface. Probing should be in 2-foot intervals in all directions within the site.

b. **Probe the Area.** If the probe suddenly has no resistance while pushing down, a crevasse is present. Attempts to outline the crevasse can be futile if the crevasse is large. Normally, the best decision is to relocate the proposed bivouac area far enough away to avoid that crevasse. (Sometimes only a few feet one way or the other is all that has needed to reach a good platform.) Probe the tent site again after digging to the desired surface. Mark boundaries with wands, skis or poles.

Table of Contents

c. **Platform.** Occasionally while probing, increased pressure will be noticed without reaching a solid platform. The amount of snowfall may be such that even after digging into the snow, the probe still does not contact a hard surface. Try to find a solid platform.

d. **Unroped Movement.** There should be no unroped movement outside the probed/marked areas. If a latrine area is needed, probe a route away from the bivouac site and probe the latrine area. If a dugout latrine is necessary, probe again after digging.

e. **Multiple Tent Sites.** Multiple tent sites can be connected, which keeps tents closer together. Probe all areas between the tents if you plan to move in those areas. Closer tents will make communicating between tent groups and rope teams easier.

f. **High Winds.** If there is a chance for severe storms with high winds construct snow walls to protect the tent site. The walls can be constructed from loose snow piled on the perimeter, or blocks can be cut from consolidated snow layers. In deep soft snow, digging three or four feet to find a consolidated layer will result in enough snow moved to build around the tent site.

(1) For block construction, move the soft snow from the surface into the wall foundation areas.

(a) Cut blocks approximately 1 by 1 by 2 feet, and constructs the walls by interlocking the blocks with overlapping placements. The walls should be slightly higher than the tent. At a minimum, build walls on the windward side of the tent site.

(b) Snow walls can also provide shelter from wind for food preparation.

(c) Walls should be as far away from the tent as they are high in case of collapse.

Identify Bivouac Discipline Procedures.

a. **Shelter Discipline.**

(1) The first man entering a finished shelter arranges all the equipment in its proper place. Place the stove, water can, firewood, tools and rations in the most convenient place by the door of the tent. In a snow shelter, a special storeroom may be dug for these items.

(2) In low temperatures, weapons should be left outside on improvised weapon racks in order to avoid condensation. Commanders MUST insure that weapons left outside are properly secured, (e.g., providing security guards or securing the weapons in an unheated shelter).

(3) Brush hoarfrost and snow off your clothing and equipment before entering the shelter. This helps keep the clothing and equipment dry and the shelter clean.

(4) To live comfortably in a shelter is not easy. Individuals are usually crowded and must keep their equipment orderly and out of the way of other occupants of the shelter.

(5) Carefully supervise the use of fire and lights in the shelter. Security, fuel economy and the prevention of fire and asphyxiation are essential. When wood is available, burn it in the stoves in place of
gasoline. Fill and light lamps outdoors. Make a stand or bracket for lamps or candles. Place them where they are least likely to be knocked over. Extinguish all sparks on the tent or lean-to at once. No smoking in the tent.

(6) Accomplish as many tasks as possible before retiring in order to conserve time in the morning. Clean all eating utensils, melt snow, fill canteens or thermos bottles, and check all weapons.

(7) Upon breaking the bivouac in the morning pack all personal equipment, consume warm drinks and breakfast, and accomplish last-minute details prior to resuming the march.

b. **Heat Discipline and Fire Prevention.**

(1) Heat discipline presents a problem during periods of extreme cold. Avoid overheating the shelter. It causes individuals to sweat and increases the fire hazard.

(2) Combine cooking and heating. Melting snow and ice uses large amounts of fuel. Use water from other sources if available. Temporary shelters have very little insulation and allow a great deal of heat loss. Heating the shelter not only allows you to get a good nights rest it allows the drying of clothing and gives you the means to provide warming liquids to those performing duties outside of the shelter throughout the night.

(3) Fire prevention is extremely important. The combination of low humidity and the drying effect of continuously heated shelters are conducive to fire. Shifts in wind and the accumulation of frost or soot in the stovepipe may lead to backfiring of flaming fuel into the shelter. Excessive spilling of fuel containers, lamps, and candles creates additional hazards. Stamping of feet to shake off snow or frost may cause stoves and small heating units to spill and spread fire. Strict enforcement of all regulations is necessary in order to decrease the fire hazard. Common sense in the handling of all kinds of fires, fuels, and flammable materials is essential. An alert fireguard must be on duty in each shelter at all times when a fire is burning. Consult applicable technical manuals prior to operating tent stoves, cooking stoves or gasoline lanterns. Place a base made from green logs under the stove if the snow has not been shoveled to the ground. Use fire reflectors to provide more warmth, and to keep the stove from melting into the snow. Check all stovepipes frequently. Clean the stovepipes daily when burning wood to maintain the proper draft and avoid excessive sparking. Stoves burning petroleum fuels at low temperatures tend to accumulate more soot. It is better to turn the stove off in mild weather than to run it at low settings. Guard against forest and ground fires when the ground is dry and bare. Coniferous forests are highly flammable during the summer season. Ground fires can burn for months in muskeg and are extremely hard to put out. Always dig a fire ditch before lighting any fire. Use a base of green wood, gravel, or rocks under the fire. The fire must be made on high ground when the forest is dry. Before leaving always be sure the fire is completely out.

c. **Drying Clothes.**

(1) Keeping dry is important in low temperatures. At times it is impossible to avoid sweating. Drying clothes and footgear is a necessity. Use every opportunity to dry your clothing. When drying clothes outside at an open fire, place clothing/footgear upwind from the fire, to avoid the sparks and smoke. Check clothes frequently. Do not leave drying clothes unattended. Clothing should never be placed too close to the fire or stove in the shelter. Leather items are extremely vulnerable to extreme heat. Clothing being dried in the shelter should be hung on the drying lines. The Tent, 10-Man Arctic, is equipped with strong hooks at the inside peak for suspending lighter weight clothing for drying. Ensure the roof vents are open and clear of obstruction to allow for maximum airflow.

d. **Sleeping Arrangements in Bivouac.**

(1) When arranging the sleeping layout for a tent or improvised shelter, the position of every man is planned. Each man must know where his relief is sleeping; therefore, the floor space is occupied by the individuals in accordance with the duty roster. The number one man sleeps next to the door; the relief is easily located without waking up all occupants. The systematic sleeping arrangement will also permit exit from the tent in an organized manner in case of alert.

(2) Ground insulation is very important. Often the occupants may have to improvise insulation using all available material. Packboards, snowshoes, man-hauled sleds, and empty cartons may be used. In timbered areas, evergreen boughs are especially suitable. On the tundra, dry lichen, grass, or shrubs provide effective insulating material. To make a bough bed, one single bed is constructed for all; the size varies with the number of persons. For improvised shelters, logs approximately 8 cm (3") in diameter are pegged or fitted around the bough or grass bed. This helps to keep the boughs in place. If material and time permit, a 15 to 30 cm (6"

to 12") thick-shingled bed made from spruce, fir, or balsam boughs gives excellent insulation and provides a soft mattress.

(3) The tactical situation dictates whether or not to use sleeping bags. The amount of clothing you wear while sleeping on a bough bed or in a sleeping bag can be best judged by experience and will depend on temperature and the tactical situation. As a minimum, remove clothing (to include boots) when using a sleeping bag. Place clothing not being worn beneath you for additional insulation and instant availability. In an emergency it may be necessary to dress in the dark. In the morning remove all ice and frost from the bag and ventilate it before rolling. Thoroughly dry sleeping bags when time permits.

(4) If the situation permits, remove your boots when sleeping in a heated tent without a sleeping bag. Use your parka like a blanket, and loosen your clothing. Your rucksack doubles as a pillow.

(5) If the tactical situation does not permit the use of a complete sleep system one alternative is to use just the seven layer clothing system. Layer seven can be used as a substitute for the sleeping system under certain circumstances. If wet weather is a concern the bivy sack may be used as a protective outer layer. This lightens a Soldiers load, and provides the ability to stay clothed and ready to fight on short notice.

e. **Choosing Bough and Firewood Areas.** The areas for cutting boughs and firewood should be immediately designated when a bivouac site is selected.

(1) *Bough Area.* The area for cutting boughs for bedding as well as for construction of improvised shelters should be common to all individuals in the group. It should be selected in a dense area of woods in which springy, unfrozen boughs are available, and should not be too close to the bivouac site. It is advisable to use sleds for hauling material to the shelter site. For camouflage and track discipline, only one well-concealed trail is used. When cutting boughs, the unnecessary felling of trees should be avoided because trees lying on the ground can be easily observed from the air. Instead of felling trees, only the lower branches should be used.

(2) *Firewood Area.* It is advisable to have the fire wood area nearby the area designated for bough cutting so that the same track can be used. Dry, dead hardwood trees make the best firewood. If no dead trees are available, green birch trees may be chopped; they possess excellent burning qualities even when frozen. The top parts of dead trees should be burned during the daytime, as they give off lighter colored smoke. The lower part of the trunk has more resin and tar, and burns better, but makes more and much darker smoke.

f. **Storage of Weapons, Skis and Snowshoes.** Storage problems in winter are increased by snow, low temperatures, thaws, limited storage space, and the increased problems of transportation. Space in any shelter is limited. Only items which are affected by cold, or which must be immediately available, should be stored inside. All other stores must be concentrated, well marked, covered, and left outside. On the other hand, some perishables, which are difficult to preserve in summer, may be kept during the winter months in a natural "deep freeze" over an extended period of time. In areas where permafrost exists, a hole can be dug or blasted out and then covered with insulating material, such as boughs. A constant low temperature can thus be maintained.

(1) *Weapons Pit.* In wooded terrain a weapons pit may be built from poles placed in a horizontal position and covered with boughs. When boughs are not available, various other materials such as empty cardboard boxes, tent or sled covers, waterproof bags or ponchos can be utilized to protect the weapons from rain, dust, and falling or drifting snow. By digging a shallow pit, with a poncho (boughs or ration case cardboard may be used) on the bottom and the other half of the poncho over the top. Two ski poles (one at each front corner) should be placed to mark the pit in the event of a snowstorm or drifting snow.

(2) *Ski Pit.* Care of skis in the field is highly important because unit and individual mobility depends upon them. If left lying directly on the snow in the bivouac area, the bindings and running surfaces will freeze and render the skis unusable for long periods of time, or they may be entirely lost under drifting snow.
Therefore, skis and the ski poles are placed in a ski pit. The pit is constructed by laying a poncho (boughs or ration case cardboard) in a shallow hole. All the skis and all but four poles should be laid on the poncho in the same order as the rucksacks. When all of the skis and the remaining poles are in place cover the equipment with the other half of the poncho or another poncho. A ski pole should be placed at the front two corners to mark the pit in the event of a snowstorm or drifting snow.

(3) *Sleds.* Sleds are placed on their sides or on end outside. If loaded sleds are left on the snow, sticks, poles, or branches are laid under the runners to prevent them from freezing to the snow. Heavy cargo sleds, 1-ton or larger, must be placed on top of heavy poles or logs due to the fact that sled runners remain hot after extensive usage and tend to settle into the snow and become frozen, making movement of the sled difficult.

g. **Vehicles.** Vehicles are driven under a big tree or into the lee of a shelter or snowdrift. Vehicles should be parked so that the least amount of snow can get into the engines and parked on brush, logs, dry ground, or other surfaces not liable to thaw from heat of tires and tracks and refreeze.

h. **Ammunition and Fuel**. Ammunition and fuel are stored separately outside. Ammunition boxes should be stacked off the ground in a dry place and covered with canvas or boughs. In order to locate stacks if snow-covered; a pole should be erected near them. Boughs or poles are placed under fuel containers to prevent them from freezing to the snow.

i. **Field Sanitation.**

(1) *Waste Disposal.* Field sanitation in colder regions is based on the same principles as in temperate climates. The extremes in climate and weather, however, make the problem more acute. The wastes that present constant and real problems are human waste, garbage, and trash.

(2) In bivouac areas, pit or "cross-tree" type latrines are used for the disposal of human waste. One latrine will usually serve the needs of individuals occupying 3 to 4 shelters, or a unit of platoon size. The latrine is placed downwind from the bivouac, but not so far from the shelters as to encourage individuals to break sanitary discipline. Ration boxes or similar material should be used to collect waste. A urinal, designated for each shelter, should be located within 4 to 5 meters (4 to 5 yards) of the shelter. A windbreak of boughs, tarpaulins, ponchos or snow wall should be constructed to protect the latrine from the wind.

(3) When breaking bivouac, the human waste that has accumulated in the latrine will be burned or buried. All closed latrine sites, tactical situation permitting, will be clearly marked.

(4) Trash and Garbage Disposal. In winter the edible portion of food waste may be collected in receptacles and disposed by burial in the snow at a safe distance from the bivouac. Every effort should be made to burn the bulk of the trash and garbage. During seasons and in locations where bears are found, all edible garbage should be burned to avoid attracting bears to campsites. All trash and garbage dumps should be marked with appropriate signs to warn troops who might occupy these disposal sites at a later time. Strict camouflage of all trash and garbage is essential. Dark trash on the white snow is easily seen from the air. The enemy may see glittering tin cans or bottles. Trash and garbage should be placed under any available cover and camouflaged with snow, branches, or other materials. Table of Contents

Identify the Ahkio Sled.

a. **Description.**

The Ahkio is the light infantry squad's primary means of transporting tents and other sustainment equipment in a cold weather environment. In addition to its' primary function of transporting the tent group equipment, the Ahkio is excellent for transporting weapons, rations, ammunition, casualty evacuation and provides a stable firing platform for crew-served weapons in deep snow.

b. **Characteristics.**

(1) Three-runner sled.
(2) Maneuvered easily over a variety of snow and terrain because of its boat like shape.
(3) Weighs 38 pounds with an attached canvas cover.
(4) It is 88" long, 24" wide and 8" deep.
(5) Maximum load capacity of 200 lbs.

c. **Towing.**

(1) Four men tow it. This is done by means of a harness and single trace assembly. It is towed for short distances over prepared trails during an approach march or similar type movement.

(2) The sled and equipment can be transported by tracked vehicles using tow bars and towed behind the vehicle.

Safety Note: The Ahkio/Tent/Stove Group contains many potential hazards. Pioneer tools and sharp metal on stove parts may cut personnel or their equipment. Liquid fuel can cause instant frostbite. Fuel vapors are highly explosive. Carbon monoxide is a deadly gas, even in low concentrations, and is particularly dangerous because it is odorless. Ensure Soldiers always fill and light stoves at least ten feet from their shelter. All stoves require ventilation when they use them in confined spaces. Ensure they avoid over pumping the fuel cell on the squad stove. If a leak develops in the stove, extinguish the flame and repair the stove immediately.

Identify the 10 Man Arctic Tent.

General Characteristics.

(1) This six-sided pyramidal tent supported by a center pole accommodates ten Soldiers with their individual equipment. When necessary, it can accommodate additional personnel. It may also be utilized as a command post, aid station or storage shelter.

(2) The tent has a liner and two doors, each of which is provided with a series of toggles and loops around their outer edges. When additional space is required, these toggles and loops allow two or more tents to be joined together with unrestricted access from one to another. For warmer climates there are flexible plastic screen doors for protection against insects.

(3) A snow cloth is attached to the bottom of the tents' sidewalls. It is used to seal the tent to the ground in order to conserve heat in exposed or wind swept areas. This is accomplished by placing insulating material such as spruce boughs, brush, cardboard or other suitable material between the ground and the snow cloth, then weighting the snow cloth with snow, dirt, logs, etc. to keep it in place.

(4) The tent is ventilated in four locations by built-in ventilators on opposite sides near the apex of the tent.

(5) Four drying lines are rigged inside the tent, on which personnel can hang wet clothing and equipment.

(6) The total weight of the tent, liner, telescoping center pole and tent pins is approximately 76 pounds. It is quite bulky and very heavy.

Table of Contents

Identify the Space Heater Arctic.

Space Heater Arctic (SHA) NSN 4520-01-444-2375

(1) The SHA provides heat in a range 15,000 to 25,000 BTU's per hour. It is designed to be used in small to medium size shelters in moderate to arctic conditions. The SHA operates with various types of liquid or solid fuel.

Identify the Safety Procedures of the SHA Stove.

a. **Safety Considerations.**

(1) Never leave a stove running unattended.

(2) Turn the stove off if leaving, even for a short period of time.

(3) Make sure all fittings on the stove fit tightly.

(4) Keep the stove level at all times to spread an even flame on the burner plate. This can be accomplished by placing a piece of wood or an MRE sleeve under the stove legs and #1 stovepipe.

(5) Protect the gas hose from being pulled on or coming into contact with the stove.

(6) Do not use excessive force on the drip valve or the hose fittings. Too much pressure at these points will damage the threads and the stove will be useless.

(7) Check the rate of fuel flow at regular intervals. The drop in fuel will change the rate fuel in the burner plate burns.

(8) If the stove goes out accidentally, close the drip valve and wait for the stove to cool down before relighting.

(9) Store all fuel supplies outside the tent to prevent an explosion.

b**. Emergency Procedures for the SHA.**

(1) Wake up occupants of the tent and set fuel ON/OFF control to OFF.

(2) Use fire extinguisher as needed.

(3) Remove fuel can from tripod.

Note: When disassembled for transport, all of the components with the exception of the stove board will fit inside the stove body, reducing the space required to pack the stove in the ahkio.

Identify the Parts of the Squad Stove (MSR XGK).

a. **Description.** The XGK is a single burner cooking unit. The stove operates on white gas, kerosene, unleaded auto gas, and aviation gas or jet fuel, and diesel with a jet change. Stove will fit in a 1.5-liter cook pot.

b. **Dimensions and Weight.**

(1) Weight (empty): 13.2 oz.

(2) Weight Packed: 17.2 oz.

(3) Burn Time: White Gas per 20oz. canister 109 minutes; Diesel per 20oz. canister 170 minutes.

Assemble the Squad Stove (MSR XGK).

a. Setting up the XGK Stove.

(1) Fill fuel bottle to fill line only. (Air space is necessary for fuel expansion.)

(2) Insert pump into fuel bottle and firmly tighten.

(3) Close the control valve, then stroke plunger. (Less fuel requires more strokes/pressure).

(4) Rotate the stove legs and pot supports.

(5) Place stove on the center of heat reflector.

(6) Insert the fuel line into pump. With fuel bottle on its side, control valve points up.

(7) Secure the catch arm on fuel pump groove. Keep fuel line straight for safety.

b. **WARNING NOTES.**

(1) An overheated fuel bottle can explode and burn or injure you. Keep it away from heat sources, such as the stoves burner. Separate burner and fuel bottle with the windscreen. Large cookware reflects excessive heat: Never use cookware with a diameter greater than 10 inches. Never operate stove with empty or dry pots. Never use aftermarket heat reflectors or diffusers.

(2) Relighting a warm stove can result in large flames that can burn you. Never light a warm stove. Let the stove cool 5 minutes before relighting. Accessible parts may be very hot. Never move a hot or burning stove.

(3) Keep any reserve fuel supply outside shelter and at least 10 feet away from the stove.

(4) Leaking or spilled fuel can ignite and burn you. Before every use, look for fuel on the fuel bottle, pump, fuel line, and burner. If you see or smell fuel, do not light the stove. See Troubleshooting. Never disconnect the fuel line, pump, or fuel bottle when the stove is in use or fuel will leak, ignite, and burn you.

(5) Provide adequate ventilation when using the stove in confined quarters. Burning gasoline will cause formation of odorless, poisonous carbon monoxide and lead oxide gases.

(6) Avoid over pumping the stove before lighting. Excess pressure within the tank may cause fuel to leak or flow too fast through the valve assembly.

(7) If a leak occurs, shut off the flame immediately and repair the leak. On the spot repair of leaks should be confined to tightening of packing nut or replacement of the gasket only.

(8) After using the stove and the flame is extinguished, allow the stove to cool.

(9) This stove can ignite combustible materials. Keep combustibles at least 4 feet away from the top and sides of a burning stove. This stove is for cooking food and boiling water only. Never use it for any other purpose. When temperatures are below -24o C (-10o F), O-rings can be stiff and prone to fuel leakage. Use extreme caution in subzero temperatures.

(10) In very cold weather or when melting snow, the incomplete combustion of fuel may produce odorless, poisonous carbon monoxide gas. You must have adequate ventilation despite outside temperatures.

(11) Do not handle fuel without proper hand wear.

Operate the Squad Stove (MSR XGK).

a. **Operating Instructions.**

(1)Release only 1/2 tablespoon of fuel. Open control valve turn and let fuel flow for 3 seconds. Close control valve. Look for fuel in burner cup and on priming pad. Light fuel A brief soccer ball size flame is normal.

(2) Wait for preheat flame to reduce in size. Open 1/2 turn and wait for steady blue flame. Slowly open control valve.

(3) Set up windscreen. Use windscreen to improve performance in all conditions. Leave a 1” gap between windscreen and pot for optimal performance. Maintain fuel bottle pressure. To maintain performance add 10 strokes every 10 minutes.

Identify the Parts of the Squad Stove (MSR Reactor).

a. **Description.** The Reactor is a single burner cooking unit. The stove operates on canisters containing a mix of iso/butane fuel that is combination of isopropyl alcohol and butane. The Reactor comes with its own 1 liter cook pot.

b. **Dimensions and Weight.**

(1) Weight (empty): 18.2 oz.

(2) Weight Packed: 18.8 oz.

(3) Burn Time: Approximately 80 minutes with an 8 oz canister. Table of Contents

Assemble the Squad Stove (MSR Reactor).

a. Setting up the Reactor Stove.

(1) Remove burner and fuel canister from cook pot.
(2) Attach fuel canister to burner unit by finger tightening clockwise.

b. **WARNING NOTES.**

(1) An overheated fuel canister can explode and burn or injure you. Keep it away from heat sources, such as the stoves burner. Separate burner and fuel canister. Only Reactor compatible pots can be used due to the design of the burner unit. Never operate stove with empty or dry pots. Never use aftermarket heat reflectors.

(4) Relighting a warm stove can result in large flames that can burn you. Never light a warm stove. Let the stove cool 5 minutes before relighting. Accessible parts may be very hot. Never move a hot or burning stove.

(3) Provide adequate ventilation when using the stove in confined quarters. Burning iso/alcohol canisters can cause formation of odorless, poisonous carbon monoxide. Adequate ventilation is necessary.

(4) After using the stove and the flame is extinguished, allow the stove to cool.

(5) This stove can ignite combustible materials. Keep combustibles at least 4 feet away from the top and sides of a burning stove. This stove is for cooking food and boiling water only. Never use it for any other purpose.

(6) Do not handle fuel without proper hand wear.

Operate the Squad Stove (MSR Rector).

a. **Operating Instructions.**

(1) Clear cooking area of combustible materials and flammable liquids or vapors.
(2) Place stove assembly on a solid, stable, even surface to ensure stability.
(3) Hold a lit match/lighter next to the edge of the Burner Screen, directly above the MSR logo.
(4) Open Flame Adjuster 3 turns.
(5) Wait for burner to become RED HOT (takes 5 to 30 seconds).
(6) Add food or liquid to cook pot. Never exceed Max Fill Line.
(7) Place cook pot onto stove by aligning it with the Burner Rim.
(8) Turn Flame Adjuster to adjust heat.
(9) When cooking is done, close Flame Adjuster.

b. **Squad Cook Set.** The squad cook set is used with the stove to make a one burner-cooking outfit. The cook set consists of two nested cooking pots and a frying pan. The cook set should only be used to melt snow and heat water. Do not heat food or other beverages in the cook set, which creates a mess and contaminates the cook set for drinking water. To melt snow for drinking water, always start with a small amount of water in the cook set.

Perform Ahkio Loading Procedures.

a. **Loading the Ahkio.**

(1) You must load the Ahkio with one end heavier then the other. Proper weight distribution is essential when packing the Ahkio.

(2) The light end becomes the front and the heavier end the rear. This weight distribution aids in maneuvering. Keep the load low and streamlined.

(3) Heavy items should be placed in the bottom and slightly to the rear of center.

(4) Loading lighter equipment toward the top will prevent the ahkio from becoming top-heavy.

Table of Contents

(5) The load should be packed in a manner, which results in the lowest possible profile to avoid a top-heavy condition.

b. **Packing the Ahkio.**

(1) Clear the Ahkio of all items. Clear the sled of snow and debris.

(2) Place all tent pegs in the bottom center of the Ahkio. Place the stove board on top of these items.

(3) Place the Space Heater Arctic (SHA) on top of stove board.

(4) Repair kit placed behind stove.

(5) Place tent cover over the stove.

(6) Water and gas cans go to the rear of the Space Heater Arctic (SHA) with caps up and opposing. This creates the "heavy" end.

(7) Center pole placed alongside SHA stove.

(8) Fire extinguisher placed along opposite side of SHA stove.

(9) Rope harnesses and miscellaneous light equipment are placed to the front.

(10) Cooking sets are placed in front of the water and fuel cans.

(11) All remaining equipment (except shovels) placed in front of sled.

(12) Tent is spread on top of all equipment from front to rear.

(13) Load the pioneer tools and snow shovels on top of the tent, wrapped in the tent cover.

(14) Load adjusted so center of balance is low and rear of center.

(15) Load adjusted to maintain a low profile

(16) Tools such as shovels, axes, saws and machetes should be packed on the sides or top for easy access when breaking trail or clearing bivouac sites.

(17) Once all equipment has been placed into the Ahkio, the canvas cover is folded over the load and the lashing ropes are secured to each other with the lashing hooks, tightened and secured.

b. **Equipment.** The amount of equipment carried in the Ahkio depends on the mission, weather and terrain. Carefully plan Ahkio loads to insure the best balance between sufficient equipment and ease of handling. Hauling an overloaded Ahkio tires troops rapidly. Unfortunately, combat situations often dictate overloading the Ahkio beyond its rated capacity.

10 Man Arctic Tent

a. **Snow Cloth.**

(1) Tuck the flap under and cover it with gear in wet-cold conditions.

(2) Fold flap out and cover with snow in dry-cold conditions.

CAUTION: IF THE SNOW CLOTH IS SPREAD INSIDE THE TENT, IT WILL PREVENT PERSONNEL FROM ROLLING OUT IN THE EVENT OF A TENT FIRE.

CAUTION: NEVER ALLOW THE SNOW CLOTH TO FREEZE TO THE GROUND. IN THE EVENT OF A FIRE, PERSONNEL MUST BE ABLE TO ROLL OUT FROM UNDER THE WALLS OF THE TENT. THERE WILL NOT BE ENOUGH TIME FOR PERSONNEL IN THEIR SLEEPING BAGS TO GET UP AND FILE OUT OF THE TENT DOOR.

b. **Ventilation.**

(1) Ventilators, near the peak of the tent, allow the tent to "breathe." Make sure you check these ventilators often and keep them open.

(2) Construct a draft channel under the tent wall behind the stove. The stove draws fresh air from outside the tent through the channel. Table of Contents

(3) Without proper ventilation a tent is a definite liability. Carbon monoxide and carbon dioxide produced from breathing and operating the stove will accumulate in the tent. Moisture will form inside the tent and the fire will not burn if the tent is airtight.

WARNING: Use of Carbon monoxide detectors is mandatory-Carbon monoxide is a deadly gas, even in low concentrations, and is particularly dangerous because it is odorless.

c. **Strike a 10 Man Arctic Tent.**

(1) Remove all equipment from tent.
(2) Brush off any excess snow or frost from both the inside and the outside of the tent.
(3) Center pole removed and adjusted to shortest length.
(4) Tent and liner doors zipped shut.
(5) Corner eave lines adjusted to full length.
(6) All other tent lines extended to full length, rolled and secured.
(7) Tent pins and door poles retrieved and accounted for.
(8) Snow, ice and/or dirt removed from the tent.
(9) Tent folded accordion style.
(a) Lift the peak and one corner of the tent off the ground. Then bring the next corner.
(b) Repeat placing and one corners together until the panels have been folded into an accordion pleat.
(c) While bringing the corners together, make sure the inside liner is folded smoothly alongside the tent.
(d) Lay the tent down, even out the folds and place the tent lines into the tent.
(e) Fold the top half down to the eave, and then fold the bottom up and over the eave.
(10) Six corner eave lines daisy chained together
(11) The ten-man arctic tent is ready for movement in the Ahkio.

Move With the Ahkio.

a. **General.**

Towing a loaded ahkio is arduous work; teams must be rotated frequently to prevent Soldiers from becoming exhausted and to prevent them from sweating through their clothing, which will expose them to a cold weather injury. Generally, snowshoes are preferred for Soldiers who will have to pull an ahkio over snow-covered terrain, especially if the snow depth exceeds one foot. Ski poles are recommended as an aid to balance.

b. **Trail Breaking.** The lead element will have the additional mission of breaking trail if snow and vegetation require.

c. **Movement Techniques.**

Winter Arctic weather and snow covered terrain means movement using snowshoes and frequently pulling an ahkio. This requires a modification of normal movement techniques.

(1) *Types of Movement*.
(a) Modified Traveling Overwatch with Ahkio.
- In the modified traveling overwatch, the squad leader and the team pulling the ahkio drop back with the attached weapons.
- On contact, the ahkio pullers will release themselves from the ahkio to support the lead team by fire and /or maneuver.

(b) Modified Bounding Overwatch with Ahkio.
- The ahkio team with the squad leader and attached weapons supports from the overwatch position as the lead team moves forward to the next position.

- The lead team occupies the second overwatch position as the ahkio team moves forward.
- The ahkio team establishes overwatch in the second position and then designates the next position for the lead teams bound.

Note: The ahkio never passes in front of the lead team. The squad leader rotates the team pulling the ahkio as necessary.
Note: The wedge is modified so that not more than three individuals break trail
Note: You can use this optional method in all the formations that include an ahkio.

Construct an Improvised Shelter.

a. **Environment and Equipment.** Your environment and the equipment you carry will determine the type of shelter you can build. You can build shelters in any area. Wooded areas usually provide the best location, while barren areas have only snow as building material. Wooded areas provide timber for shelter construction, wood for fire, concealment from observation, and protection from the wind. Shelters made from ice or snow usually require tools such as ice axes or saws. Things to consider when building a shelter:

(1) You expend a lot of time and energy to build a shelter.

(2) Ventilate an enclosed shelter.

(3) Always block a shelter's entrance, to keep the heat in and the wind out. Use a rucksack or snow block.

(4) Construct a shelter no larger than needed. This will reduce the amount of space to heat. A fatal error in cold weather shelter construction is making the shelter so large that it steals body heat rather than saving it. Keep shelter space small.

(5) Never sleep directly on the ground. Lay down some pine boughs, grass, or other insulating material to keep the ground from absorbing your body heat.

(6) Never fall asleep without turning out your stove or lamp. Carbon monoxide is a great danger. It is colorless and odorless. Always check your ventilation. Even in a ventilated shelter, incomplete combustion can cause carbon monoxide poisoning. Usually, there are no symptoms. Unconsciousness and death can occur without warning. Sometimes, pressure at the temples, burning of the eyes, headache, pounding pulse, drowsiness, or nausea may occur. The one visible sign of carbon monoxide poisoning is a cherry red coloring in the tissues of the lips, mouth, and inside of the eyelids. Get into fresh air at once if you have any of these symptoms.

Note: In extreme cold, do not use metal, such as an aircraft fuselage, for shelter. The metal will conduct away from the shelter what little heat you can generate.

b. **Snow Cave.**

(1) *Choosing a Site for the Snow Cave*. Choosing the site for the snow cave, a site free of any avalanche danger should be selected. Look for a drift near ridges or trees. A depth of at least 4 or 5 feet is helpful to start with. Many areas do not have this depth of snow available. To overcome this problem, snow must be formed into a large pile. This pile should be designed large enough to accommodate the number of people that the shelter will house. To form the snow pile, begin moving snow onto a site that will provide a flat and stable base. Continue adding snow until a rounded pile is formed at least 4-5 deep and as long and wide as it needs to be for the number of people it will accommodate. It is better to start with more snow than you think you might need. The newly formed pile needs to be left undisturbed for at least an hour before any digging is attempted. This time allows the snow crystals to begin to bind together and gives the snow cave strength and stability. This binding time varies depending upon the

type of snow, the moisture content, and the air temperature. It is possible that in some conditions, such as granular or corn snow that the snow crystals will require a longer time to form this bond and in some cases not form a bond at all. In these situations other types of shelters need to be considered. When using this method, smaller shelters will be easier to build. If there is a large number in a group, it will be more effective to build several smaller caves. Heavy digging can be done with a large scoop shovel. Smaller avalanche shovels work well also. In an emergency situation where a shovel is not available, use whatever you can improvise, including your hands. A small cooking pot, a snowshoe, ski or even a signal mirror will work. Try to arrange the entrance to the cave so that it is on the leeward side of a slope. This will offer additional protection from the wind.

(2) *Tunneling In*. In deep snow begin by digging a trench downward into the snow. As you dig place the snow that is being removed from the trench onto the roof area of the cave. In these conditions make the trench as deep as you are tall. The next step is to begin tunneling in. At a point at about knee level make the entrance. Make the tunnel slightly wider than your body. If the terrain and snow depths are adequate, tunnel at a slight upward angle. Ideally the cave end of the tunnel should be at least a foot above the entrance; this will help prevent warm air from escaping the shelter. If possible make the tunnel the length of your body. At the upward end of the tunnel hollow out a space as large as your body. Moving the snow becomes a major task at this point. Use the shovel in front of your body to dig in. As you move forward use your feet to move the snow into the tunnel and out of the entrance. Now you are ready to begin shaping the cave.

(3) *Shaping the Snow Cave*. The minimum thickness of the cave walls should be 12 inches. The thicker the walls the more stable the structure and the better it will insulate. The ceiling and the walls of the shelter should be dome shaped and smooth and should be large enough for you to sit upright. Try to eliminate any sharp edges or ridges on the walls and ceiling of the cave. Initial shaping can be done with a shovel to do the bulk of the work. Final shaping is best done with a gloved hand. This shaping will prevent water-dripping problems as the temperature in the cave rises.

(4) *Finishing Touches*. An elevated sleeping platform is the most important feature you can add to your shelter. This allows you to be nearer the warmer air in the upper part of the cave. Another necessary feature is the ventilation hole that can be made with a stick, ski pole or other object. This hole should be made in the top and be about 2 inches in diameter. This helps to eliminate carbon monoxide if stoves or candles are used and carbon dioxide build-up from your own breathing. Check the vent hole at regular intervals to prevent it from becoming clogged. Leaving a stick or ski pole in the hole is a good idea. To clear the vent holes just wiggle the inserted object. Make a shelf for a candle. Once lit, a candle can increase the air temperature in a small cave by as much as 20 degrees or more. Others shelves and platforms can be created for gear and equipment. The entrance to the cave can be blocked with a snow block, pack or other gear. This will help to reduce air movement and increase the temperature inside.

Note: On occasion during the construction of a snow cave, especially in granular snow, a collapse can occur. It is a good practice to build caves in teams of two. During the construction, one person should always remain on the outside. In case of a collapse the outside person can then rescue the person digging. It is uncommon for a snow cave to collapse after construction, especially after the temperatures drop at night. The cold temperatures tend to increase the overall strength of the shelter.

Note: The ceiling of a snow cave can drop as much as 1-2 inches per day. This occurs because of normal settling of the snow pack. During a heavy storm the settling can increase drastically. When this occurs just reshape the inside of the cave. Always keep your shovel or digging device next to you in a snow cave. After a storm you may need to dig your way out.

c. **Emergency Snow Caves**. In an emergency, snow caves can be created quickly by digging into a snow bank or drift. Eliminate the tunnel and dig a compartment so that it is large enough inside for you to sit upright. Place your pack in front of the entrance hole. Use evergreen bows or other natural materials to insulate yourself from the ground. Use your pack as an emergency bivy sack and light at least one candle. If you use a candle make sure you have a vent hole or adequate ventilation. If you think people will be out searching for you, make the site as visible as possible from the ground and the air by placing clothing, sticks or stomping an unusual pattern in the snow. Remember when you are inside the cave your ability to hear what is happening outside will be reduced to almost nothing.

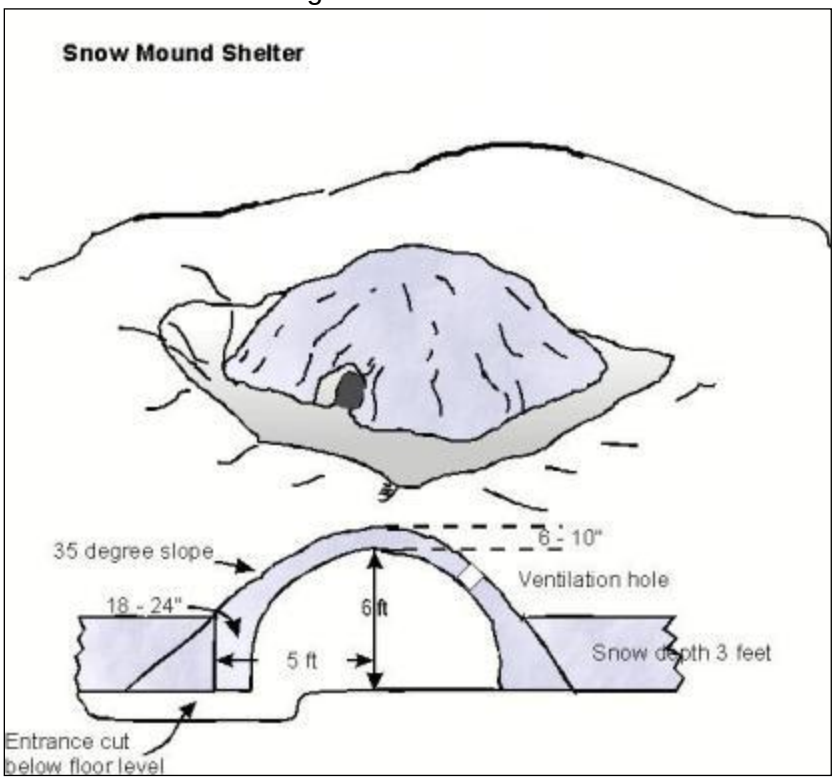


Figure 1
Snow Mound Shelter

d. **Snow Trench.** A snow trench can be built very quickly and will shelter two people. At least 3-4 feet of reasonably level snow is required.

(1) Start by digging a slot about shoulder width and a little shorter than a sleeping bag.

(2) While one person digs, another can build a wall around the windward end with the excavated snow.

(3) Dig straight down until the trench is 3-4 feet deep. There will now be room for two people to sit in the trench.

(4) Insulating mats can be used as the floor.

(5) If you have skis with you the roof can be made by lying two ski poles across the trench then sliding a pair of skis into a bivy bag and placing this across the poles. Use snow to hold the ends down. Get in and out of the trench by lifting one corner of the roof and sliding in.

(6) If you are going to spend the night, dig out the sides at the bottom to make slots you can slide your legs into so you can stretch and lie down.

(7) The size of the trench is determined by the size of your roof. If you have a double size bivy bag or a tent flysheet you can dig a bigger trench and stretch the roof out, weighing down

each side with snow and perhaps using upright poles or skis as roof supports from inside. Such a large trench will hold more people than the grave type, but the roof is much more vulnerable to collapse.

(8) A small trench will be warmer than a big one and quicker to dig.

(9) Overall, if your need is to get out of the wind quickly, several trenches are better than one large one. If it looks like your stay will be prolonged, a more solid roof can be put on a snow grave by using snow blocks to make an A-frame-style roof.

(10) When you leave a snow trench, fill it in and stamp the snow down.

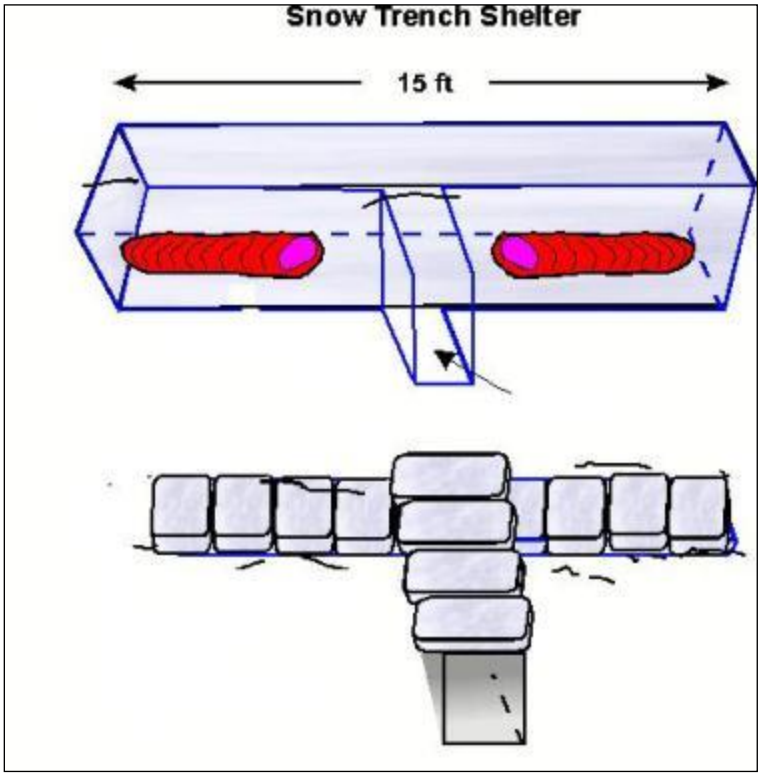


Figure 2
Snow Trench Shelter

Table of Contents

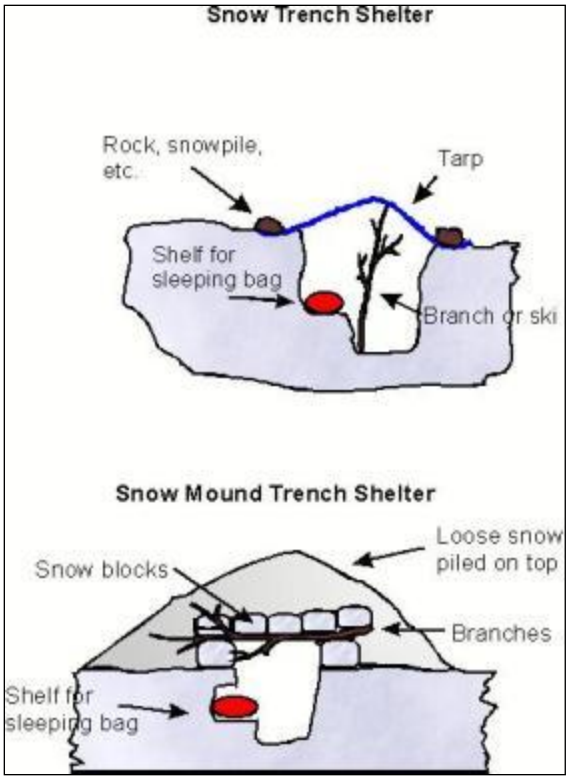


Figure 3
Snow Trench Shelter

e. **Snow Block and Parachute Shelter.** Use snow blocks for the sides and parachute material for overhead cover. If snowfall is heavy, you will have to clear snow from the top at regular intervals to prevent the collapse of the parachute material.

f. **Lean-To Shelter.** Construct this shelter in the same manner as for other environments; however, pile snow around the sides for insulation.

g. **Tree-Pit Shelter.** Dig snow out from under a suitable large tree. It will not be as deep near the base of the tree. Use the cut branches to line the shelter. Use a ground sheet as overhead cover to prevent snow from falling off the tree into the shelter. If built properly, you can have 360-degree visibility.

Table of Contents

Notes:

Figure 4
Snow Cave Shelter

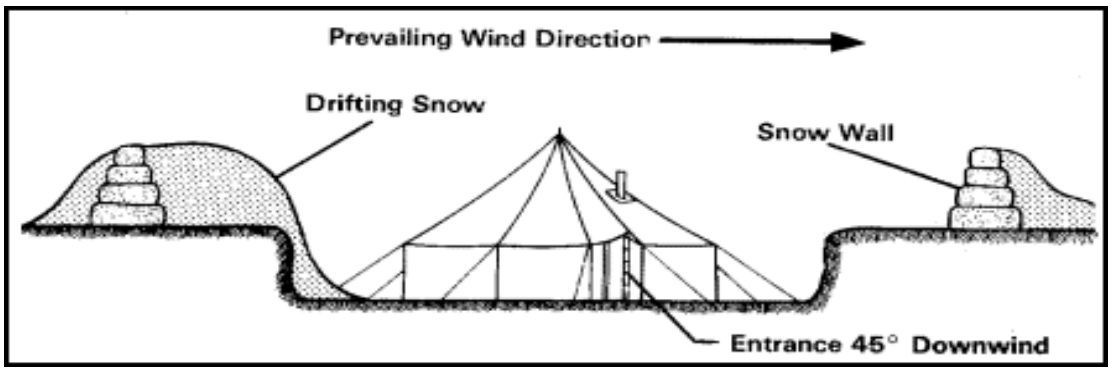


Table of Contents

Notes:

27 - Aerial Resupply

071E9069

INTRODUCTION: AAR notes from the 10th Mountain Division's Operation Anaconda (Mar 02) noted the lack of preplanned aerial resupply and the difficulties in resupplying units in contact. Aerial resupply techniques give units options that do not rely on ground convoys or increased Soldier loads. Smart SOPs, pre-configured loads and leaders who understand the pros and cons of the various types of aerial resupply are key to effective aerial resupply.

Considerations for aerial resupply.

a. Substantial distances from forward operating bases (FOBs).
b. In remote, austere locations that are hard to reach by ground transportation.
c. With limited or no material handling equipment (MHE) to conduct recovery or retrograde operations.
d. In locations with no usable airfields or airstrips to conduct air-land operations.

Methods of aerial resupply.

a. **Speedball.** Constructed simply by filling a duffel bag or similar sized container with resupply items and securing the contents inside. When over the DZ the bag is kicked out the door. Speedballs have a high rate of failure for delivering resupply items undamaged. Speedballs tend to burst upon impact with the ground and scatter the contents over a large area.

b. **Poncho Parachute.** The poncho expedient parachute can be used to drop up to 65 pounds of non to mildly sensitive equipment and lessens the need for more expensive parachutes. The load requires a buffer to protect load. Constructed by attaching lengths of 550 cord to a poncho at the grommet points. The individual lines are then brought together and secured to a light bundle. Poncho parachutes have an average 70% success rate in delivering the resupply items on target and undamaged. Tests should be conducted to determine the correct maximum weight that the poncho will support to increase the chances of success.

c. **Low Cost Low Altitude (LCLA).** The LCLA family of parachute systems for aerial resupply consists of five aerodynamic decelerator configurations capable of handling payloads weighing 30-500 lbs, delivering payloads from 100-2000ft of altitude, and costing no more than $375. The LCLA only requires a 50M drop zone. The system is flexible and simple enough to be quickly rigged with no specialized rigger or loadmaster training; can be airdropped from commercial or military fixed-wing aircraft, helicopters or unmanned aerial vehicles.

Table of Contents

Poncho Parachute Construction.

a. First, pull the hood drawstring loop to close the hood opening, then wrap the excess drawstring tightly around the base of the hood and tie it off so no hair will escape. Leave at least a one inch loop in the poncho hood drawstring to secure ¼" cotton breakaway.
b. Fold the poncho in half length wise (bottoms together) with the snaps down.
c. Cut nine suspension lines 8-10 feet in length, one will be the static line.
d. Tie one suspension line to each of the eight grommets on the poncho with a bowline knot.
e. Ensure the suspension lines are not tangled and are the same length.
f. Tie all the free ends of the suspension lines to a snap link with a bowline minus the safety.
g. Fold the poncho as follows:
(1) Lay the half-folded poncho flat. Length wise.
(2) On both long sides of the poncho, make "S" folds 6 to 8 inches wide to meet in the center (there should be the same number of folds on both sides).
(3) Fold the narrow-folded poncho into an "M" fold.
h. Construct the deployment bag, use a sandbag. Punch a hole just below the seam, tie the fixed looped end of the static line to the sandbag, turn inside out, then tie the fixed loop of the static line to the drawstring (which is wrapped around the hole of the poncho) with one loop of 25 LB. test cord (or a light weight string that will break when the bundle is deployed from the aircraft) and tied with a square knot. If using 1/4" cotton webbing, cut it 2/3 of the way through to ensure it will break.
i. Attach the load to the snap link that is attached to the suspension lines.
j. "S" Fold the suspension lines on top of the load.
k. Then place the "M" folded poncho parachute on top of the folded suspension lines.
l. Affix the poncho parachute to the top of the load with one wrap of 25 LB. test cord in the same manner as tying a package, ensuring the cord goes through the loop in the static line. Tie with a square knot. This will deploy the suspension lines prior to breaking loose from the aircraft.

Quick Guide for Weights.

a. **Duffel bag capacity.** Each Duffel bag can hold one of the followings:
(1) 36 MREs (approximate weight 66lbs)
(2) 3 cases of 5.56, linked ammo in plastic drums (approximate weight 225lbs)
(3) 3 cases of 7.62, (8) 100round boxes per sandbag (approximate weight 225lbs)
(4) 3 cases of 5.56 packed by bandoleer (approximate weight 200lbs)
(5) 70 (1) liter water bottles (approximate weight 152lbs)

Summary.

Aerial resupply provides the commander with ability to decrease the need for vehicle based LOGPACs in an austere environment. Thus reducing the potential for loss of life. The method of aerial resupply is based on the resources available, aircraft and type of material to be resupplied.

References.

a. Field Manual 4-20.103 (MCRP 4-11.3C, TO 137-1-11), Airdrop of Supplies and Equipment : Rigging Containers
b. Field Manual 3-20.220, Basic Airborne Techniques, Training & Procedures
c. Training Circular 1-240, Aircrew Training Manual, CH-47D (Task 2064 Chapter 4)

Table of Contents

28 - High Altitude Illness and Prevention

071E9023

Introduction: Conducting combat operations in the mountains exposes Soldiers to unique conditions that can rapidly make unprepared units combat ineffective. Understanding the effects of altitude on Soldiers and the steps necessary to mitigate or prevent these effects will significantly increase a unit's operational capability.

Identify Acclimatization Considerations.

a. **Acclimatization and Conditioning.** Training in mountains of low or medium elevation 5,000 to 8,000 feet does not require acclimatization procedures. Poor physical condition will decrease performance even at low altitudes. All non-acclimated Soldiers display some altitude effects above 8,000 feet.

b. **Acclimatization.** When you can live and function physically and psychologically, you are acclimated to that elevation. The acclimatization process begins when you arrive at the higher elevation. If the change in elevation is large and abrupt, some Soldiers will suffer the symptoms of acute mountain sickness. Disappearance of symptoms (4-7 days) does not suggest complete acclimatization. The process continues for weeks or months. Attempts to acclimatize beyond 17,000 feet results in a degradation of the body greater than the benefits gained.

Identify Acclimatization Methods.

a. **Deployment to High Elevations**. There is no way to shorten the acclimatization process and the absence of acclimatization hampers operations. The following measures are important:

(1) *Ascend by Stages.* Spend 2 or 3 days at each stage, beginning at 8,000 feet and subsequent stages of 2,000 to 3,000 feet increments, will insure that the ultimate destination is reached. By this time, a considerable degree of acclimatization will have occurred, mountain sickness greatly reduced and the operational potential greatly increased.

(2) *Pre-treatment.* Pre-treating Soldiers with Carbonic Anhydrate inhibitors such as Acetazolamide (Diamox) will reduce the incidence and severity of acute mountain sickness.

(3) *Local Acclimatization.* Begin acclimatization in CONUS or another safe area before deployment to the operational area. Deploy to the operational areas by rapid transport once acclimatization is complete.

(4) *Rest Cycle.* If troops are moved directly to high altitudes, the first 3 to 5 days must be a period of relative inactivity.

(5) *Nutrition.* Plan for and ensure sufficient caloric intake at higher elevations to accommodate increased work output.

(6) *Water.* Danger from dehydration is as high in mountain regions as in hot dry areas. Plan on at least 4 quarts per day when in bivouac and 6 quarts per day when active. Boil water and snow from an unknown source for a minimum of 1 minute to kill bacteria and microorganisms.

Identify High Altitude Medical Problems.

Medical problems associated with high altitude include several uncomfortable and life threatening conditions. All are primarily the result of a decreased oxygen concentration in the blood caused by the lower atmospheric pressure at high altitude. Altitude illness does not occur on the highest mountains only. More people are more affected between 8,000 and 12,000 feet than at higher altitudes. Many examples confirm that not only altitude and rate of climb, but also the length of stay and the effort expended, decide whether an individual will or will not have some kind of altitude illness.

a. Identify Acute Mountain Sickness.

(1) *Definition.* Acute Mountain sickness is a temporary illness.

(2) *Cause.* Rapid ascent over 8,000 feet in elevation.

(3) *Signs and Symptoms.*

(a) Sickness, sluggishness, headache.

(b) A headache is the most distressing symptom and may be severe. Even when a headache is not present, there is a loss of appetite.

(c) Nausea occurs even without food intake.

(d) Vomiting may occur and will contribute to dehydration.

(e) Despite fatigue, a Soldier will be unable to sleep.

Note: The symptoms usually develop and increase to a peak intensity by the second day, then gradually subside over the next several days. The headache may last until the Soldier returns to lower elevations. Most Soldiers WILL experience some degree of Acute Mountain Sickness at elevations above 8,000 feet.

(4) *Treatment.*

(a) Consists of relieving the headache with non-aspirin substitutes.

(b) The patient should wear sunglasses since bright sunlight seems to aggravate the headache.

(c) Reassure the Soldier.

(d) Encourage fluids and light foods in small frequent amounts.

(e) Moving the Soldier lower 2,000 to 3,000 feet may alleviate the symptoms.

(5) *Prevention.*

(a) Acclimatization.

(b) Moving at progressive staged ascent, slows assumption of physical activity.

(c) Protection from cold.

(6) *Miscellaneous*

(a) We are subject to this sickness at altitudes as low as 8,000 feet.

(b) Incidence and severity increase with altitude and when transport to high altitudes is rapid.

(c) Indications are that substantial disability and ineffectiveness can occur in 50 to 80 percent of troops rapidly brought to altitudes in excess of 12,000 feet.

(d) At lower altitudes or where ascent to altitudes is gradual, the lessened severity of the sickness will allow a majority to carry out assignments with moderate effectiveness, although with some discomfort.

(e) Arrival at high elevations 8,000 to 14,000 feet commonly feels well for the first few hours. A feeling of exhilaration or well being is not unusual. There may be an initial awareness of breathlessness upon exertion and a need for frequent pauses to rest.

(f) Breathing irregularities can occur, particularly during sleep. Individuals who become aware of these changes may exhibit some apprehension.

(g) The true onset of symptoms begins 4 to 12 hours after arrival at the higher altitude.

b. Identify Sleep Hypoxia.

(1) *Definition.* A slight drop in arterial hemoglobin oxygen saturation occurs due to a decrease in the rate and depth of breathing.

(2) *Cause.* Decrease in arterial oxygen during sleep.

(3) *Signs and Symptoms.* Inability of many individuals to sleep well at high altitude. It may also explain why headache and other symptoms of acute mountain sickness are more severe during the night.

(4) *Treatment.* Diamox can relieve the severity of sleep hypoxia.

(5) *Prevention.* None.

(6) *Miscellaneous.* During sleep at sea level, a slight drop in arterial hemoglobin oxygen saturation occurs due to a decrease in the rate and depth of breathing. During sleep at high altitude, the decrease in ventilation of the lungs is more marked, fluctuates widely and arterial oxygen saturation may reach very low levels.

c. Identify High Altitude Pulmonary Edema.

(1) *Definition.* HAPE is a swelling and filling of the lungs with fluid caused by rapid ascent. It occurs at high altitudes and limits the oxygen supply to the body.

(2) *Cause.* Rapid ascent to heights over 8,000 feet.

(3) *Signs and Symptoms.*

(a) Progressive dry cough that becomes productive with frothy white or pink sputum.

(b) Cyanosis or the turning blue of the face, hands, and feet will occur and will become more intense.

(c) Most victims have the symptoms of acute mountain sickness. The early pulmonary difficulties may not be primary or striking.

(d) Closely observe personnel with acute mountain sickness for increasing ill feeling, labored breathing, repeated clearing of the throat, and development of the dry cough and an increase of difficult and labored breathing at night.

(e) In rapidly progressive cases, the onset of respiratory difficulty may be quite sudden, associated with a choking feeling and rapid deterioration.

(f) Oxygen Saturation < 80-85% (Determined with pulse oximeter).

(4) *Treatment.*

(a) Prompt treatment consisting of rest, warmth and oxygen.

(b) Immediate evacuation to lower altitudes 3,000 feet by air if possible. The patient should not be allowed to descend on foot, as physical work accelerates HAPE.

(c) Medical personnel should consider administering morphine for the systemic vasodilatation, Furosemide (Lasix) given orally as a diuretic, Nifidipine (Procardia), a calcium ion flux inhibitor, decreases contractility and oxygen demand and Diphenhydramine (Benadryl) which alleviates the histamine response that increases mucosal secretions.

(d) If immediate descent is not possible, place patient in a hyperbaric chamber if available (Gamov bag) to increase atmospheric pressure.

(e) If untreated, HAPE will become irreversible and lead to death. You can expect recovery in cases that are recognized early and treated promptly.

(f) Individuals who have had a previous attack of HAPE are more prone to have subsequent attacks.

(5) *Prevention.*

(a) Acclimatization.

(b) Moving at a progressively staged ascent slows assumption of physical activity.

(c) Protection from cold.

Note: A program of acclimatization, as indicated under acute mountain sickness can largely prevent HAPE. Immediate descent is the BEST treatment for HAPE.

(6) *Miscellaneous*

(a) High altitude pulmonary edema is the most dangerous of the common types of altitude illness.

(b) HAPE is encountered exclusively at high elevations and characteristically occurs in individuals experiencing mountain sickness.

(c) HAPE is characterized by high mortality.

(d) Incidence and severity increase with altitude.
(e) Except for acclimatization, there is no known resistance or immunity.
(f) Cases are rare on the day of arrival and infrequent after the fourth day. There are few cases after more then ten days at altitude.
(g) The incidence of HAPE is much less frequent than that of mountain sickness.
(h) Factors contributing to HAPE include: a history of prior high altitude pulmonary edema, a rapid or abrupt transition to high altitude, strenuous physical exertion, exposure to cold and anxiety.
(i) A drop in the concentration of oxygen in the blood results, eventually causing cyanosis, impaired cerebral function and finally death by suffocation.

Note: Depending upon the ease versus hazards of evacuation, the use of rest, warmth and oxygen may be preferable to a hasty evacuation to lower elevations.

d. Identify High Altitude Cerebral Edema (HACE)

(1) *Definition.* HACE is the accumulation of fluid in the brain, which results in swelling, and a depression of the brain function that will result in death.
(2) *Cause.* Rapid ascent to heights over 10,000 feet aggravated by overexertion.
(3) *Signs and Symptoms.*
(a) Rare below 10,000 feet.
(b) A severe headache seen lower is an early form.
(c) Takes several days to develop but rarely comes on swiftly.
(d) Characterized by increasing headache, poor judgment, auditory or visual hallucinations, in coordination, stumbling walk (ataxia), drowsiness, coma and death.
(4) *Treatment.* Descent is mandatory, urgent and often the only effective treatment, as well as rest, warmth, and oxygen.
(5) *Prevention.*
(a) Acclimatization.
(b) Moving at a progressively staged ascent slows assumption of physical activity.
(c) Protection from cold.
(6) Misc.
(a) Cerebral edema develops over the course of a few days. It is quite unlikely to happen on Mount Rainier where altitude exposure is usually limited to two days and maximum sleeping altitude is 10,000 to 11,000 feet.
(b) It is not uncommon in the Everest region where altitude exposure is at least seven days and maximum sleeping elevation varies from 16000 to 18000 feet (possibly even higher).

Note: Immediate descent is the ONLY treatment for HACE.

e. Identify High Altitude Retinal Hemorrhage.

(1) *Definition.* Hemorrhages within the eyes at altitude.
(2) *Cause.* Retinal hemorrhages may develop at altitudes as low as 9,000 feet they are common above 16,000 feet. They are asymptomatic unless in the macular region and resolve rapidly. Small hemorrhages may also occur under the nails, in the kidneys, and in the brain.
(3) *Signs and Symptoms.* Small hemorrhages in your eyes. Possible decrease in vision.
(4) *Treatment.* Require no treatment. Resolving while the climber remains at high altitude. Permanent damage is uncommon, but has been reported.
(5) *Prevention.* None.

Table of Contents

f. Identify High Altitude Systemic Edema.

(1) *Definition.* Swelling of tissues at altitude.

(2) *Cause.* Mechanism unknown, but presumably similar to fluid retention in AMS.

(3) *Signs and Symptoms.* Swelling of feet, hand, eyelids and face. Nuisance but harmless/clears up upon descent.

(4) *Treatment.* Treat with diuretics or descend.

(5) *Prevention*. None. Avoiding salt may help.

Identify Fluid and Nutritional Requirements While Operating at Altitude.

Energy requirements for Soldiers operating at elevations above 8,000 feet will increase 15-50% over that needed at sea level for comparable exertion, depending on the elevation and type of mission. Soldiers should
expect to expend up to 6,000 calories per day depending upon the temperature, altitude and physical activity. Operations at altitude in rough terrain require mental toughness and physical stamina. Hydration and appropriate (adequate) calorie intake is essential for maintaining peek operating performance. Leadership and individual preparation for sustaining operations in a high-altitude environment is essential.

a. **High Altitude Hydration Requirements.**

(1) *Factors That Cause Dehydration.*

(a) Increased urinary output due to cold diuresis.

(b) Water loss from the lungs from increased ventilation of cold dry air.

(c) Sweating from increased physical exertion.

(d) Vomiting and diarrhea, especially in the first few days at altitude.

(e) Water purification and water resources may be unavailable or limiting.

(2) *Considerations for Proper Hydration.*

(a) Maintain a sustainable water requirement of a minimum 5 quarts per Soldier per day

(b) Drink water consistently throughout the day as tolerated.

(c) Maintain hydration especially when first arriving at altitude, this may decrease the effects of AMS.

(d) Soldiers will not “feel” the urge to drink, although the water requirement has increased.

(e) Water purification must be available. Boiling water may be limiting as the fuel requirement to boil water increases with altitude (longer boiling times).

(f) Water will freeze as the temperatures decrease. Consider insulating containers for hydration systems.

(g) Water gathered from local sources must be considered contaminated and appropriate purification methods should be used.

(h) Cold Weather Rations (RCW) require water to rehydrate food contents. Water is also required for food absorption within the body, so adequate water should be ingested with a dehydrated meal.

NOTE: Proper hydration in a high-altitude environment is critical to Soldier sustainability and mission success. It is very easy to become dehydrated as the urge to drink decreases with altitude. Dehydration exacerbates the effects of altitude, environmental injuries, increases fatigue and impairs judgment.

Table of Contents

c. **High Altitude Calorie Requirements.**

(1) *Adequate Calorie Intake.*

(a) Soldiers can be expected to burn between 4,500 – 6,000 calories per day while operating in a high-altitude environment.

(b) Suggested daily energy allowances (4,500 calories) for high-altitude operations can be consumed in 4 MREs' or 1 Ration, Cold Weather (RCW). The RCW requires about 3 quarts of water to rehydrate all of the food contents. As a rule of thumb, it requires about 2 pounds of food per Soldier per day (excluding packaging) to sustain caloric intake for energy expenditure while at altitude. A high-carbohydrate diet is desired, as it will replace muscle energy stores and keep blood sugar levels balanced. A low blood sugar level combined with the effects of altitude can lead to disorientation, confusion and lack of coordination.

(c) Calorie intake should be in the ratio of 60-65% carbohydrates, 20-25% fat, 10-15% protein.

(d) Drinking carbohydrate-loaded beverages can be easily tolerated and helps to ingest calories and remain hydrated. 400-600g of carbohydrates per day (60-70% of dietary energy) is suggested for optimal performance. This is difficult to achieve unless Soldiers consistently drink carbohydrate-loaded beverages or snack on easily digested high-carbohydrate foods. The first 24-72 hrs after arriving at a higher elevation may produce nausea and vomiting. Warm, carbohydrate based fluids are well received and can help with energy and fluid requirements if solid food cannot be tolerated.

EXAMPLES:

- Carbohydrate Beverages include Beverage Base Powders, Electrolyte Packets found in MRE and RCW, Gatorade, PowerAde, Cider, Cocoa, Sweet Tea etc…
- High-Carbohydrate foods include Cereals, Crackers, Fig Newtons, Breads, Dried Fruits, Granola Bars, Bagels, and Pastries etc…

(e) MREs' and RCWs' provide adequate protein requirements for operations at altitude. A high fat diet is discouraged as the energy requirements for metabolism are increased. If high fat foods are desired, consume them with high carbohydrate foods. MREs' and RCWs' provide enough vitamins and minerals that supplementation is not needed.

NOTE: Everything is harder at altitude. It will take discipline and constant monitoring to maintain proper food and fluid intake throughout the day. Meals should be eaten warmed if applicable and "snacking" should be encouraged throughout the day. Bring foods that you know you like to eat because your appetite will diminish as you gain altitude.

Table of Contents

Notes:

29 - Confined Space Exploration and Clearing

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INTRODUCTION: Confined spaces are found on the current battlefield in the form of wells, caves, collapsed buildings, and water and waste systems. Learning the skills needed to safely operate in and properly clear these danger areas will enhance your ability to deny the enemy use of these areas.

Identify Characteristics of a Confined Space.

a. Confined spaces can be technically challenging due to the environment in which they occur. Confined spaces are often narrow and constricting preventing easy access. They are usually either unlit or poorly lit so Soldiers must provide their own light source. Finally, confined spaces often contain hazardous materials in liquid or gas form, which can be harmful or fatal to Soldiers.
b. Vertical confined spaces are usually found in the form of abandoned wells or cave entrances. These spaces are often used to cache weapons or other hostile material. Wells must be checked for booby traps as well as poisonous gasses prior to sending in a Soldier.
c. Horizontal confined spaces are found in cave systems and structure collapses. These spaces must be thoroughly checked for stability prior to entering.

Identify the Tactical Considerations of a Confined Space.

a. Enemy situation
b. Mines, Booby Traps, IED's
c. Depth
d. Water
e. Actions at the Well
f. Clearing Techniques
g. Special Equipment Considerations

Identify Confined Space Anchoring Considerations.

a. Vehicles provide easy anchoring possibilities for a hauling or lowering system. Ensure the vehicle wheels are chocked securely, and sharp edges are padded.
b. Use additional height to create a high directional to safely lower and raise a Soldier into the space. This can be a tripod, and existing tree/structure, or a vehicle parked closely.
c. Natural anchors such as trees, rocks, and earth anchors may be used if available.

Identify Confined Space Belay Techniques.

a. Body Belays are a quick method to assist a Soldier entering a less than vertical space when solid anchors are unavailable. Realize that body belays only prevent a slip from becoming a fall – stopping an accelerating Soldier with LCE and weapon will be very difficult.
b. Mechanical Belays such as the Munter Hitch are used when there is a good anchor and the Soldier can climb down and up the space unassisted.
c. High friction lowering systems, such as the munter hitch, can be used for vertical to overhanging wells or when the entering Soldier is carrying extra heavy equipment, such as air monitoring equipment or demolition equipment.
d. Hauling Systems complement lowering systems – the support team must be able to construct a mechanical advantage system to quickly raise the Soldier out of harm's way.

Table of Contents

Perform Individual Movement Techniques in a Confined Space.

a. Single Line Rappelling can be used if the Soldier wants to control his own descent. Give extra care padding edges as there is no redundancy with a single rope. Either a top belay with a second rope or a self-belay must be used to have hands free capability.
b. There are various ascending methods available. Prusik ascent is a simple method, although slow and fatiguing. Pre-tie your stirrups to speed the process. Another choice is using two mechanical ascenders if available. This method is much faster and less tiring.

Table of Contents

Notes:

References.

Field Manuals:

FM 3-97.6	Mountain Operations, dated November 2000
FM 3-98.61	Military Mountaineering, dated August 2002
TC 21.24	Rapelling, dated January 2008

Organizations:

U.S. Army, Asymmetric Warfare Group www.awg.army.mil
US Army Northern Warfare Training Center AK
PEO Soldier PM SCIE Mountain Equipment

NSNs For Mountaineering Equipment:

11mm Static Rope	Fixed Ropes/Rappelling/ Rope Bridges	4020-01-320-4113
Tubular Webbing 1”	Anchors, Etc	8305-00-268-2455
7mm Cord	Anchors, Etc	4020-01-317-8183
11mm Climbing Rope	Lead Climbing/Rappel Seats	4020-01-318-9713
Fig-8 Descender	Rappelling	8465-01-319-4690
Oval Carabiners		8465-01-322-7433
12mm Locking Carabiner		8465-01-322-7432
9mm Rope	Fixed Ropes/Rappelling	4020-01-318-9712

Other Items:

Locking Pear Shaped Carabiner-Jake Screw Gate By Omega Pacific 1-800-360-3990

Black Diamond Alpine Body Harness- Geoff@Bdel.Com 1-801-278-5552

Local Purchase Rope / Mountain Equipment Sources:

Www.Bluewaterropes.Com
Www.Climbhigh.Com

Local Purchase Snowshoes, Stoves, Mioxx Water Treatment Pens, etc:

Www.Msrgear.Com

Squad Stoves:

MSR XGK (Multi Fuel-White Gas) or MSR Reactor (canister)

Recommended Mountain Equipment For a Light Infantry Platoon:

Each Soldier:

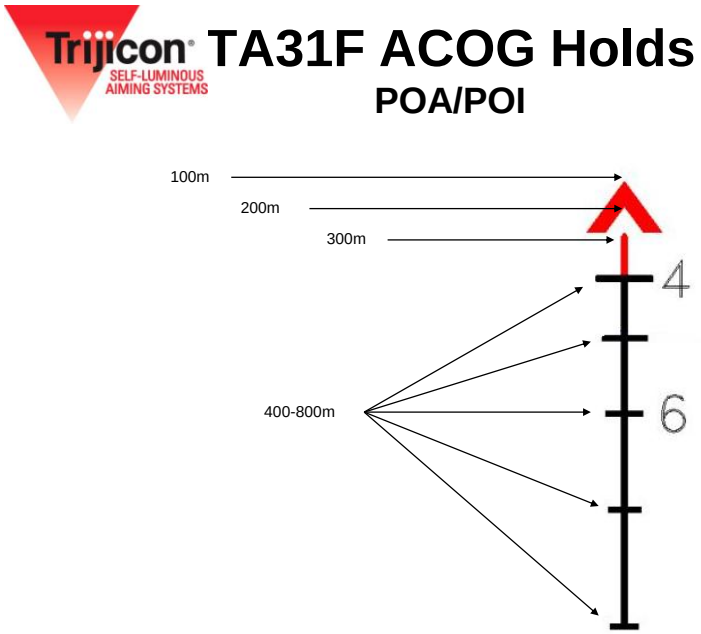
1 Each	7mm X 18 Feet Cord
1 Each	11mm X 15 Feet Sling Rope
1 Each	Pear Shaped Locking Carabiner
1 Each	Non-Locking Carabiner
1 Each	Tubular Webbing – 60” X 1”

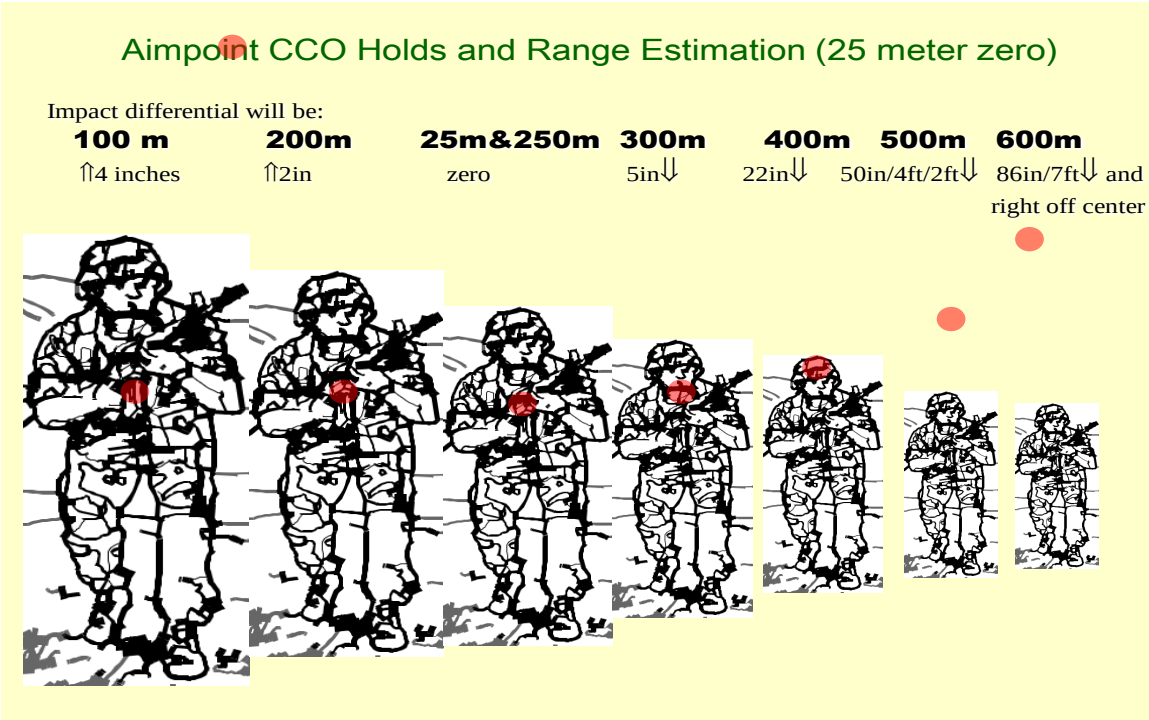
Per Platoon:

2 Each	11mm X 300’ Static Rope
2 Each	11mm X 165’ Dynamic Rope
2 Each	Sked Litter (Complete)

Table of Contents

Appendix A – Long distance holds for current issue M4 optics (ACOG, CCO)





The untrained mountain Soldier has two foes- the enemy and the mountain. But he can make a friend and ally of the mountain by learning to know it. The mountain can give him cover and concealment, points of vantage and control, even, at times, food, water, and shelter.

"Proposed Manual for Mountain Troops."
Mountain Training Center, October 1943